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RETURN TO 207 MARKET ST. GENERAL EXPERIMENTAL CLERK ELECTRIC DEPT. NEWARK, N. J.

THE MOST MODERN HOTEL PLANT IN THE WORLD

The Mechanical Equipment of the Bellevue-Stratford, Philadelphia

In these modern days of engineering, the use of superlatives is dangerous because no sooner is it said that a certain plant is the finest and best equipped, or that a certain dynamo or turbine is the largest in the world, than it is found that some other plant or some other piece of machinery is being made to outrival its predecessor in that distinction. This is also true of hotels which now not only represent all that is modern in the art of building and decoration and which must contain conveniences almost unthought of elsewhere, but they also represent the acme in engineering ingenuity; so that it can be said with all these thoughts in mind and without any equivocation that the Bellevue-Stratford Hotel is the most modern hotel in the world in all of its appointments.

The building itself occupies a site 205 x 220 feet in the heart of Philadelphia. It is a fire-proof structure, 18 stories high, with basement and sub-basement. The mechanical plant is situated in the sub-basement, as are also the refrigerating plant, large wine rooms, a large sized laundry and an extensive system of locker rooms for the hotel attendants. This sub-basement is very high and spacious, so that some of the machinery is situated on mezzanine floors. In the basement are the kitchens, Turkish and Russian baths, café and children's dining room. The lobby occupies a large part of the main floor, there being a main dining room at one corner, a gentlemen's café at the other corner, and a palm garden in the rear. On the floor above the main floor there are situated a number of private dining rooms; a magnificent ball room, 68 x 108 feet is situated directly above the palm room, and extends through the second and third stories.

The majority of the other floors are very similar, there being some fifty-three bed rooms and forty bath rooms on each floor. A corridor extends through the centre of each floor connecting with a corridor of each wing. At the junction of these corridors on every floor, there is a floor clerk who has charge of the annunciators connected with the rooms on that floor and the pneumatic tube system. There is also a service room, or pantry, on each floor supplied with dumb-waiters and pneumatic tube connection to the main kitchen. The rooms themselves are equipped with all the conveniences that human brain can devise, among which may be mentioned the telephone, safes for jewelry, open fireplaces, electric heaters and electric curling irons.

Some idea of the many things necessary in this building can be obtained by the fact that it contains seven hundred miles of copper conductors, 14,000 incandescent lights, seventy-five miles of steam pipe, three miles of pneumatic tube, ten miles of large feeder cable, sixty-six miles of small wire conduit, boilers and engines and dynamos for generating power, air compressors, feed pumps, elevator pumps, fire pumps, 100-ton ice plant, feed water heaters, hot water generators, filters, artesian wells, elevators, telephones, steam laundry, cold storage rooms and many other things which are necessary to run the hotel.

The boiler room is in the sub-basement and is about 40 x 100 feet in area. It contains five 300 horse power boilers of the horizontal water-tube type, built by Aultman & Taylor Co. They are each equipped with Ross, Stevenson & Co.'s pop valves, Jenkins' lever safety valves and Reliance water columns.

The prominent feature of the boiler room is the Wilkinson stoker. By their use none of the 50 tons of coal used per day are handled, and the capacity of these boilers can be increased 50 per cent. above their nominal rating. They are equipped with water motors, which are regulated automatically by the steam pressure on the boiler, and the speed with which the coal is fed to the grates depends upon the load on the boilers. The feeding is accomplished by the motion of the grates in a continuous back and forth motion of the grate bars, which maintain a uniform thickness of fire by a gradual descent of the fuel from the top to the bottom of the grate, depositing the clinker and ash in the ash pit. Since the fire doors never have to be opened, the boiler room can be kept at a very comfortable temperature. These stokers were specified without competition, having been in operation for several years in the Waldorf-Astoria Hotel, New York, which is under the same management.

The bunkers for storing the coal and feeding the boilers are

opposite the boilers, underneath the pavement, and have a capacity of 700 tons. In order to give the chutes the necessary pitch and, at the same time, get a sufficient storage capacity, it was necessary to build the coal pocket in two parts, the upper part being separated from the lower by a steel plate bottom, which is fixed at an angle of 30 degrees tangent to the coal chutes. A slide operated by a lever in the boiler room is provided in this steel bottom so that the coal can be dumped into and kept as storage in the lower pocket.

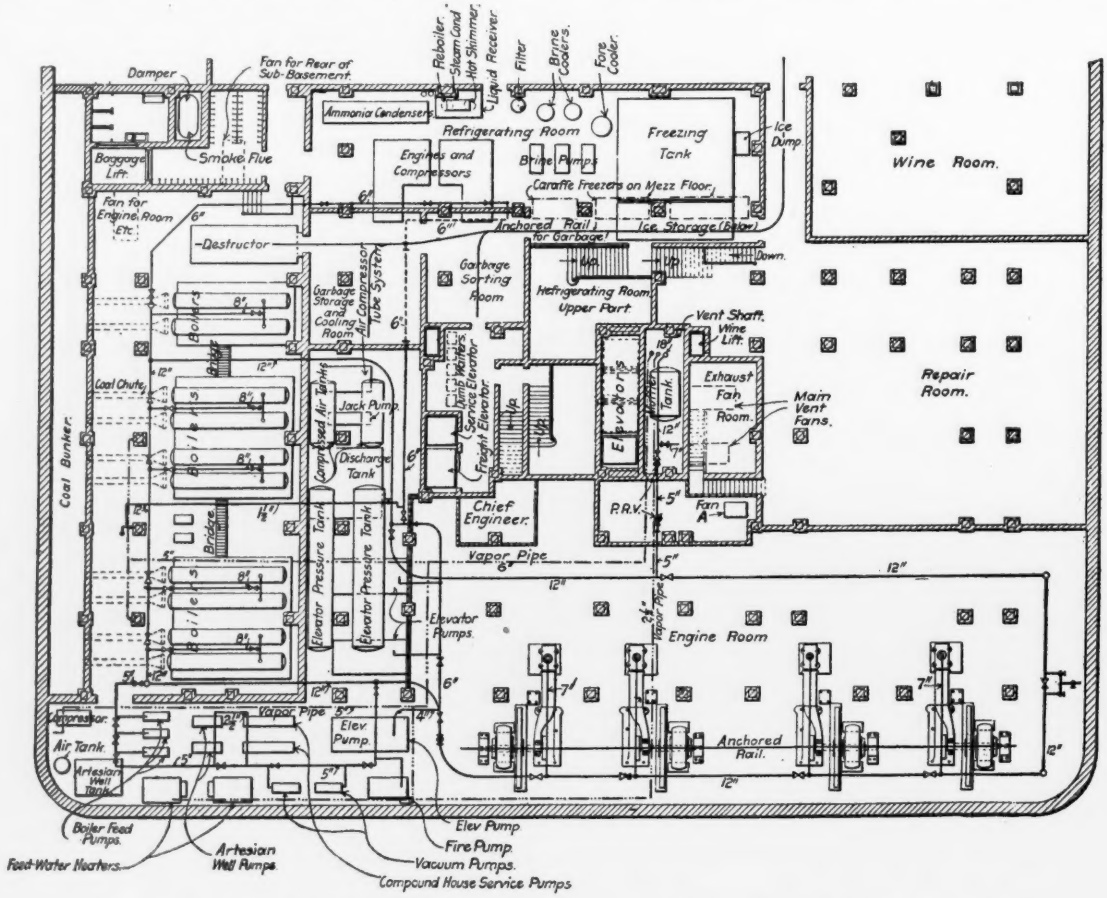
Whenever for any reason it is necessary to use the coal in the lower pocket, a conveyor built by the Exeter Machine Works, conveys the coal from it and dumps it into the upper pocket. The conveyor is driven by a 15 horse power Diehl electric motor. For handling the ashes, industrial railway tracks run from the boiler room to a bucket elevator. The ashes are loaded on these cars and discharged into a hopper at the bottom of the bucket elevator, built by the Link Belt Engineering Co. The elevator lifts the ashes a height of 55 feet and dumps them into a telescopic chute which leads directly to the ash cart placed beneath it. The elevator can be driven at a speed of 230 feet per minute with a 7½ horse power motor to which it is connected.

Each boiler is fed from the coal pocket by two chutes, with expanded ends for distributing the coal to the Wilkinson stoker hoppers. The flue gases are carried in an underground duct of brick to the smoke stack, which is an oval steel flue about 4 feet by 8.5 feet and 310 feet high. In the boiler room there is also a Morse-Boulger destructor, which is used for burning up sweepings and waste; two blow-off tanks, pumps of the Deane type, 6" x 5¾" x 6" in size, and two Worthington duplex pumps, 6" x 4" x 6" which are used for pumping the surface drainage water into the sewer.

The boilers use anthracite coal, No. 1 buckwheat size, and, at the present time, 50 tons are required per day. The boilers carry a steam pressure of 125 pounds per square inch. The steam is used for driving the large engines, auxiliary engines, refrigerating machines, pumps, air compressors, and in the laundry.

The feed water is pumped to the boilers through two Cochrane feed water heaters from the city mains by three 7½" x 5" x 6" outside packed plunger duplex Deane pumps, which are situated east of the boiler room in the pump room. In the pump room there are also two Deane 7½" x 4½" x 12" duplex pumps for pumping artesian well water, two Deane compound house tank pumps 6" x 9" x 5¼" x 12", one Worthington duplex fire pump 18" x 10" x 12", two Deane vacuum pumps, 8" x 14" x 18", two Cochrane open feed water heaters, one Ingersoll-Sergeant air compressor, an air tank and an artesian well tank.

The Ingersoll-Sergeant air compressor lifts water from three artesian wells, which are 500 feet deep, into the artesian well tank just mentioned. From this tank, the two artesian well pumps pump the water into two tanks, 19' x 10' x 5' each, on the 17th floor. This water is used in the lavatories, pavement washing and in the ammonia condenser in the ice plant. The



Plan of the Mechanical Plant in the Sub Basement of the Bellevue-Stratford Hotel

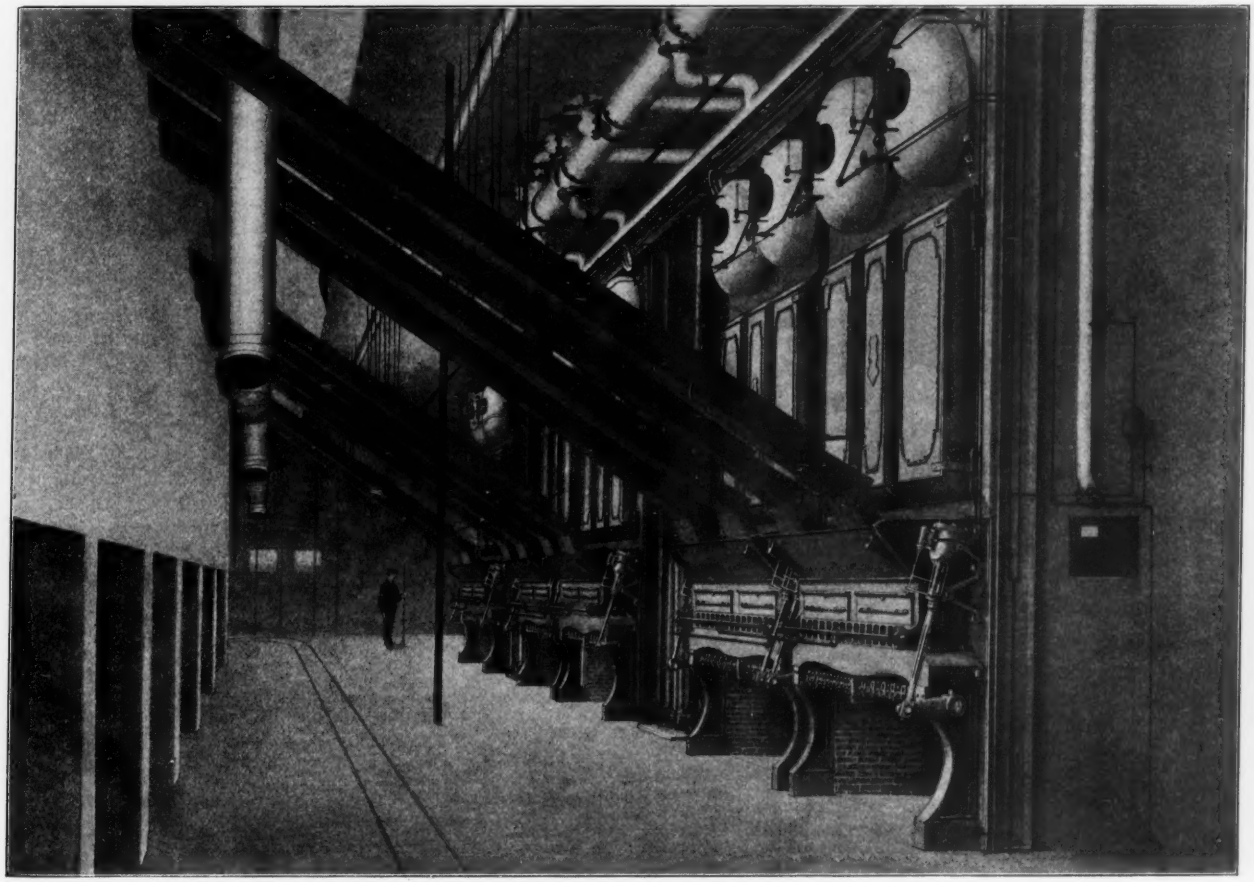
house tank pumps pump filtered water from filtered water tank, on the mezzanine floor directly above them, to four filtered water tanks 18′ x 20′ x 5′ and two 34′ x 12′ x 5′ tanks located on the 17th floor. This water is used for baths, laundry, kitchen, etc. The fire pump is connected to the fire lines throughout the building. These pipe lines are also connected to two tanks located in the towers on the 18th floor, which have a capacity of 14,500 gallons of water. The water in the tanks is always available for immediate use, a check valve being so arranged that when the pressure of the fire pump exceeds that derived from the tank, it closes and the hose lines are operated from the fire pump, which has a capacity of 1000 gallons per minute.

Above the pump room is a half story or mezzanine floor on which are located the eight Loomis-Manning filters, two Berryman hot water generators, built by I. B. Davis & Sons, filtered water tanks, elevator pressure tanks and compressed air tanks for pneumatic tube system.

The pneumatic tube system is run by compressed air derived from one Ingersoll-Sergeant duplex compressor, and one Knowles single compressor located near the engine room. The compressed air tubes, which are used for transmitting messages between the different floors and different departments, all centre at one place on the main floor. A message that is to be sent from the engine room to the 16th floor, for instance, goes to the central station and is there relayed by the operator into the proper tube, there being a station on each floor. A bell boy takes the message upon arrival at the given floor to the proper person or room.

Besides the pumps mentioned, there are three Worthington compound elevator pumps, 18″ x 29″ x 14″ x 18″, which pump the water to a pressure of 150 pounds, one Worthington jack pump 9″ x 4½″ x 12″, and one 2″ x 3″ triplex motor driven Deane pump which is used for pumping the water from the distilling plant to tank located on 17th floor, from where it is distributed throughout the buildings and is used for drinking and cooking purposes only. These pumps are located in the engine room, and farther along toward the refrigeration room are two 5″ x 7″ x 7″ American air compressors, which are used in connection with the Schone system for ejecting the sewage, from the collecting tanks in the sub-basement, into the sewer.

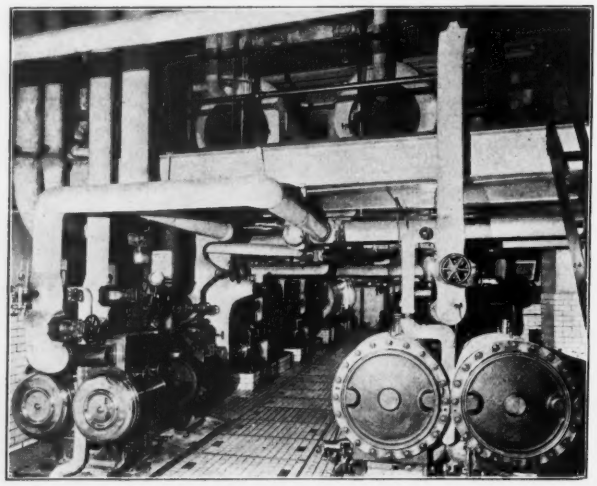
The steam distribution to supply all these numerous pumps and machines is interesting. From the boilers, the steam flows into a 12-inch header, which is connected to two 12-inch mains, one at each end, which go around the plant, meeting at the far side. This forms a loop, and steam can be supplied in either or both directions from the boiler. By an arrangement of by-pass valves, each boiler can be cut out of circuit and each engine can be cut out from the supply pipe without affecting the flow of steam and should any accident happen to any section, by simply closing the valves on each side of the section, repairs can be made without affecting the rest of the loop. The ele-



Boiler Room showing Boilers, Coal Chutes, Ventilating Ducts and Wilkinson Stokers

vator pumps also have their 6-inch main connected across each side of the loop so that they can be fed from either side of the 12-inch header.

The pumps in the pump room are supplied from a 5-inch main, which is connected to the 12-inch main leading from boiler to engine room in such a manner that steam can be taken from two points. The refrigerating machines are connected



Pump Room of the Bellevue-Stratford Hotel showing Mezzanine Floor and Hot-water Generators

to one end of the 12-inch header by a 6-inch main, which also runs in the form of a loop and joins the 6-inch main which feeds the heavy duty elevator pumps and air compressors, and which also enables the apparatus in the refrigerating room to receive steam under all conditions.

In general it may be stated that all the main steam pipes are connected in a complete loop equipped with valves so that any boiler, pump or engine can be cut out of the loop without stopping the flow of steam in any way. All the high pressure lines are drained by means of the Holly system, which returns the water of condensation back to the boiler by means of the steam loop principle.

The exhaust pipes from the engines and pumps are, as far as possible, carried in ducts under the floor to the two feed water heaters in the pump room by a 12-inch main, the 18-inch exhaust main going through a shaft in the building to the roof. The exhaust pipe is capped with a Sterling exhaust head about 330 feet above the engine room floor. This exhaust main is also used for the riser of the heating system, and, at the engine room floor, is connected to a Baldwin grease extractor and a muffler tank, with arrangements for by-passing the extractor. The oil from the extractor is trapped to the drip tanks in the boiler room. At the 17th story, the 14-inch heating main branches off from the exhaust riser, above which is the 18-inch back pressure valve which is by-passed to prevent any possibility of this valve not working properly.

The engine room, which is about 55 feet by 130 feet, contains four Allis-Chalmers Corliss engines 22" x 40", which run at 100 revolutions per minute. They are equipped with safety devices, force-feed lubricators and Keystone grease cups, the bearings being oiled from the oiling system. They are directly connected to 250 kilowatt Western multipolar 120 volt generators. The engine room is very high and from the liberal spacing which is between the engines, it might be supposed that ground was not valuable. The floor of the main engine room as well as the other engine and pump room, is covered with cream colored bevel-edge tiles. The tops of trenches in which the exhaust pipes are laid are also covered with tiles, which are carried in frames, and which are carefully insulated with Nonpareil Cork on the inside to prevent any radiation of heat into the engine room. A 10-ton hoist which runs on a trolley above the engines is available for repair work.

The main switchboard, which is located along one side of the engine room, is beautifully constructed of white Italian marble. It is arranged in 9 panels, the total length being 32 feet and height 9 feet 3 inches. The dynamo leads run directly to the main switchboard in conduits under the engine room floor. The back of the switchboard represents the very latest construction, there not being a wire to be seen; all the switches, circuit breakers, instruments and bus bars being connected by means of bus bars, making a very neat arrangement with minimum loss of potential. The generator feeders go to the three centre panels, and the three panels on each side are used for feeder panels. The four main switches are of the three pole single throw type, and neatly arranged along the whole board are two general electric watt meters, five Weston voltmeters and 4 ammeters, 40 distributing double pole single throw switches, each provided with an I. T. E. circuit breaker.

The lower floors, which use the heaviest load, are fed directly from the switchboard, but on all the floors above the second they are fed to four points on every fourth floor, the distribution being two floors up and two floors down from each of the four points. The electric load consists principally of 14,000 incandescent lamps, 26 arc lights used in the laundry, 530 electric heaters for curling irons, 26 electric irons in laundry, and valets' rooms, and 320 horse power motor load. The motors include two 25 horse power motors connected to the main fresh air supply fans, two 20 horse power connected to the main exhaust ventilating system, three 7½ horse power fireplace exhaust fan motors, three 6 horse power motors on toilet room exhaust, one 10 horse power motor for engine room fresh air supply, one 15 horse power for coal conveyor, one 10 horse power for ash hoist, one 55 horse power for washing machine in laundry, two 3 horse power motors for running the manglers, one 5 horse power for the collar and cuff machine, one 1 horse power for the potato peeling machine, one ½ horse power for the knife cleaning machine and one ¼ horse power for the coffee grinder.

Alongside of the main switchboard is a smaller switchboard used to control the current for the call bells, fire alarms, elevator signals and in connection with pneumatic tube system. It is constructed of white Italian marble in the same beautiful manner as the main board and is 7½ feet wide by 8 feet high. There is no voltage on this board higher than 15 volts, four Crocker-Wheeler motor generators being used to reduce the voltage from 115 to 15. On this switchboard are six Weston ammeters, 3 voltmeters, 26 double throw switches, 7 single throw switches, and 4 I. T. E. circuit breakers.

The refrigerating plant, which is also located in the sub-basement, is the next thing that draws one's attention. It has a capacity of 100 tons a day and supplies a 10-ton ice making tank, some 40 refrigerators scattered throughout the building, and furnishes cold for an arrangement for freezing 300 carafes. The ammonia compression system is used, there being two 50-

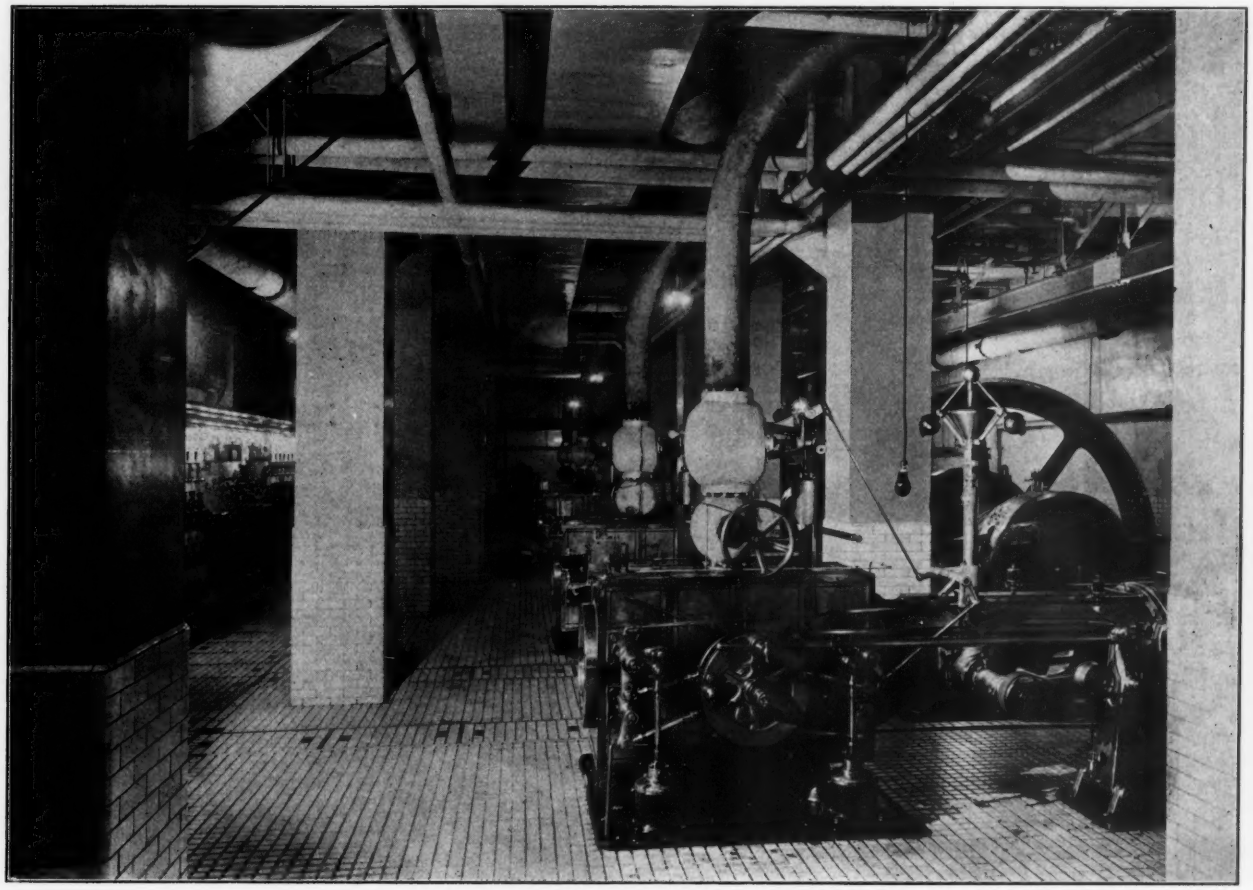
ton machines, each having a 20" x 24" horizontal cylinder with Corliss valve gear and two single acting vertical compressors. The ammonia goes through a double pipe condenser, which receives its water from the artesian well tank into a liquid receiver, all the liquid ammonia being expanded in the brine coolers. The exhaust steam, which is condensed and used for making the ice, passes through a grease extractor, a condenser for liquefying the steam, a reboiler, a skimmer, two filters, forecooler and again filtered into a receiving tank. From there it passes into the ice tanks.

The brine is pumped by three Worthington pumps, 10" x 6" x 10", regulated automatically by Foster valves. Two systems of brine distribution are used. One pump supplies the high pressure system which is used for the refrigerators in the serving rooms on the different floors, while another pump supplies the low pressure system which is used for the refrigerating apparatus in the lower part of the building, the third pump being used as a reserve.

The freezing tank acts as storage for the brine, from which the pumps pump it through the brine coolers and, after the brine has performed its work throughout the building, it returns to the freezing tank, when it is still cold enough to freeze the water. The freezing tank is 21 x 23 feet and accommodates 160 300-pound cans, which are filled from the fore cooler by an automatic filler and which are thawed by spraying warm water on their sides. The ice is handled by a Weatherson air hoist, which dumps the cake into a storage room.

Besides the refrigerating rooms on each floor, the brine is used in a series of cold storage boxes located on the mezzanine floor in the sub-basement. There is one room for champagne, (yum, yum, they keep this locked) one for meats, one for milk, butter and ice cream, one for oysters and clams, one for mineral waters and beer, one for fruit, butter and cheese, one for flowers, one for vegetables and one for ale. All of these rooms must be kept at a different temperature, ranging from 26 degrees for the champagne to 50 degrees for the ale. There is also a large room for the storage of the garbage and a room for sorting garbage, both of which are kept at a temperature of 35 degrees.

The elevator plant consists of three compound Worthington duplex pumps regulated by Mason regulators at 150 pounds water pressure. The two pressure tanks, 61" diameter and 31 feet long are above the pumps, the usual air cushion being maintained above the water by a Westinghouse locomotive type air compressor. The discharge tank, which is 14 feet square and 7 feet high, is situated near the pumps. The elevator equipment consists of 6 passenger elevators and 4 freight elevators, all of the plunger type, built by the Standard Plunger Elevator Co. The longest plungers are 285 feet in length, which is practically the height of the building, and when the elevator is at the sub-basement the plunger extends into the ground 285 feet below the sub-basement level. They are of hollow construction, 7½ inches in diameter, and are made up in sections screwed together. There are also 12 dumb-waiters and lifts



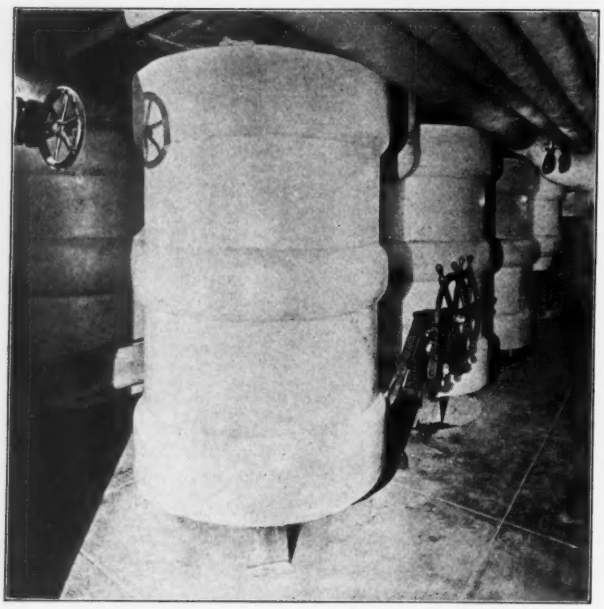
Engine Room of the Bellevue-Stratford Hotel

for sending meals to the different floors. They are operated by a call bell system from the basement and by placing a lever on a certain number, which designates the floor on which the waiter is desired, the elevator will travel to the floor designated and stop automatically.

The compressed air equipment is used for the pneumatic tubes, oil feed for engines, and the sewage system. The pneumatic system was installed by the Lamson Consolidated Store Service Co. The compressed aid is furnished by an 8″ x 14¼″ x 8″ Ingersoll-Sargeant duplex and a 10″ x 16″ x 18″ Knowles direct acting compressor, which pump the air into two storage tanks. A 25-pound pressure, under which the pneumatic system works, is maintained automatically on both tanks. The sewage lift comprises four Shone ejectors, which are supplied by 5″ x 7″ x 7″ American air compressors.

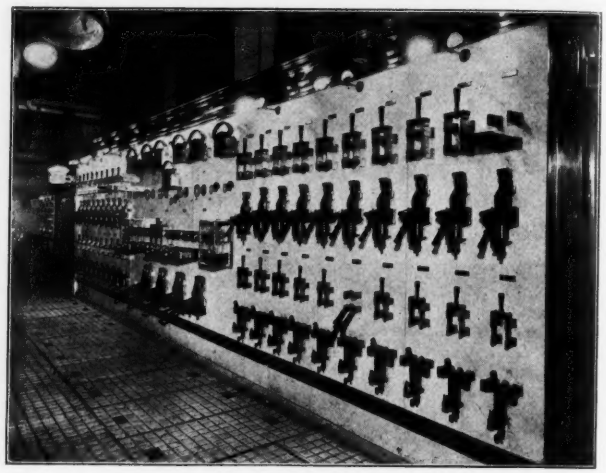
The oil system for the engines is run by compressed air. The oil is forced from a closed tank by means of compressed air to all the bearings of the engines, the drips from which run into a tank below the engine room level. From this drip tank, the oil is pumped into a tank situated well above the engine room floor, from which it flows through a McClellan filter into a pure oil tank. From the pure oil tank the oil is pumped by a 4½″ x 2¾″ x 4″ Worthington duplex air pump into the closed tank, thus completing the circuit. The level of the oil in this tank is controlled by a float which in turn controls the air admission valve to the pump. When the level of the oil falls below a certain level it opens the valve and the pump forces oil into the tank until the float closes the admission valve. This arrangement is situated on one corner of the main engine room.

The building is heated by direct radiation, the radiators being hidden wherever possible. The heating main branches off from



Filters and Pipes located on Mezzanine Floor showing method of Insulation

the exhaust pipe at the 17th floor and supplies a system of overhead mains with branches which drop down in the outside wall. The Webster vacuum system is employed, the return pipes from the thermostat valves on each radiator lead to the vacuum pumps in the pump room. The lower floors are heated from a 7-inch main in the sub-basement. The heating system is arranged to receive live steam when necessary. The live steam connection is made from the 12-inch loop in the engine room by means of a 5-inch connection which is expanded through reducing valves to 12 inches in diameter and joined into the 18-inch exhaust riser. Besides supplying the lower floors with the necessary radiating surface, the system supplies 3850 square



Beautiful and Modern Switchboard in the Engine Room of the Bellevue-Stratford Hotel

feet of radiating surface on each floor and the Turkish and Russian bath rooms in the basement.

The ventilation system is also necessarily very elaborate. The fans are of the centrifugal type driven by Diehl motors, the aggregate capacity of which is 194 horse power. Some of the fresh air fans are located on the 17th floor, where a good quality of air is obtained, the air being discharged downward to the lower stories, where it is heated and distributed. There are eight systems of ventilation employed, one for the main rooms on the ground and first floors, one for the palm garden, one for the ball room, one for the kitchen, one for the engine and boiler rooms, one for the other rooms in the sub-basement, one for the lavatories and one for the fireplaces in most of the bed rooms.

The first six systems mentioned work on the plenum and exhaust fan system, while the last two are solely exhaust systems. These systems of ventilation are very extensive and too complicated to describe in this short article, but it might be interesting to describe briefly the kitchen and engine room system of ventilation.

The kitchens are supplied with fresh air from two fans mounted on the same shaft and driven by a 7½ horse power motor. The air is exhausted partly through ducts which lead to the central ventilating system, and partly through ducts which run from the hoods over the ranges to the air space surrounding the smoke flue. The engine and boiler rooms are supplied with cold air forced through spouts distributed over the two rooms. The fan for doing this is 6 feet in diameter and is driven by a 10 horse power motor at the rate of 225 revolutions per minute. There are eight discharge openings in the boiler room and eight in the engine room, each of which is 16 inches in diameter. The air in the bed rooms is exhausted through the fireplaces by three 7½ horse power fans.

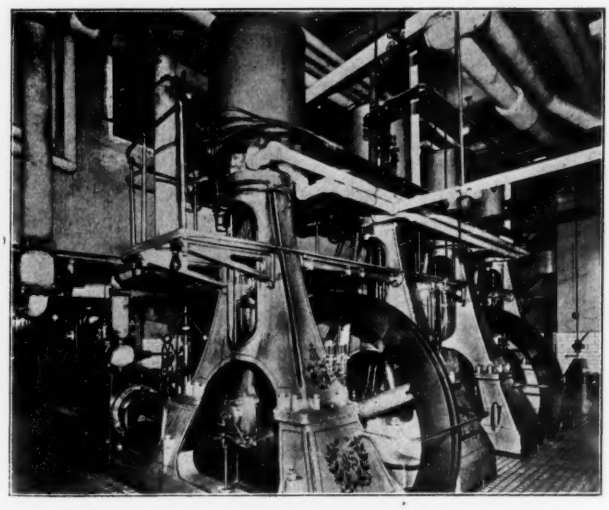
The care with which all the steam, exhaust and water pipes are covered, as well as the brine pipes and other parts of the

plant calls for more than passing notice. The specifications throughout the building called for Nonpareil cork covering, and there has been no operation in this country where the matter of insulation has been carried out in such detail as on this building.

The live steam pipes are insulated with covering 1½ inches thick; the live steam drips and the Holly system with the same grade; the exhaust pipes and boiler feed lines are insulated with Nonpareil cork of the standard thickness. The main steam line of 12-inch pipe, which runs in a loop about 500 feet long, has a combination covering of ¼-inch asbestos, then 1¼-inch cork lags of proper bevel and then a heavy coat of cork cement finished with heavy canvas sewed on. The feed water heaters, hot water generators and 18-inch exhaust separator, are insulated with air space, then 1½ inches of cork cement and a hard finish. All of the service pumps are insulated on cylinders and steam chests with cork cement, then a Russian-iron jacket with brass bands and spun brass heads. The artesian well water tanks and filtered water tanks are protected with 2-inch sheet cork and finished with white hydraulic cement.

The heating mains in basement, risers to roof branches on 17th floor and down feeds, are insulated 1-inch thick cork applied with copper wire. The cold air ducts which supply fresh air to the building are insulated with air cell boards and hard finished. The hot and cold water mains, risers, and branches are covered with standard thickness of cork, as is also the artesian water and drinking water lines from basement to 17th story. The eight filters, through which all the city water used in the building is filtered, are insulated with cork lags 2 inches thick, then plastered and hard finished to prevent sweating.

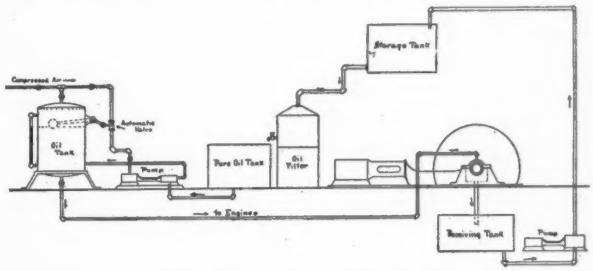
On all exposed pipes in basement and sub-basement, the covering was wired on, the joints made tight, then heavy paper with a heavy canvas jacket as a finish was applied. The ventilating ducts from kitchen to stack were covered, where exposed, with air space cork cement and hard finish; the flues from ranges and stoves with double air space. On the cold



Refrigerating Machines located in Sub-Basement of Bellevue-Stratford Hotel

pipes of the refrigerating plant, Nonpareil cork brine covering is used and in the ice making and carafe tanks granulated cork is used. The brine coolers are insulated with cork lagging and sheets 3 inches thick. The ice water tanks and pipes are insulated with sheet cork 1½ inches thick.

As a matter of general interest, to show what degree of care was exercised in protecting all hot and cold surfaces, there was used approximately 83,000 linear feet of sectional pipe, covering in sizes from ½ inch to 10 inches, about 7500 square feet of lags for steam pipes above 10 inches in size and for filters, 1800 square feet of sheet cork for tanks, 54,000 square feet of air cell boards, 6500 lineal feet of brine covering, exclusive of moulded covering for all fittings and lagging and



Oiling System used in Engine Room

sheet cork for filters. There was also 5 tons of granulated cork used on the cold tanks.

Mr. G. F. Shertenleib is the chief engineer of this extensive and model plant; the building was designed by G. W. & W. D. Hewitt, of Philadelphia; the mechanical equipment was designed by Francis Bros. & Jellett, of Philadelphia; the steam piping, steam heating and ventilation system were installed by L. H. Prentice Co., New York. Mr. John R. Livezey, of Philadelphia, agent for Nonpareil cork products, installed all the hot and cold insulation. Wm. P. Ogelsby, of Philadelphia, was the plumbing contractor, the Geo. A. Fuller Co., of New York, who were the general contractors for the entire building, installed the electrical layout and the Wilkinson Manufacturing Co., of Bridgeport, Pa., installed the stokers.

The Care of Shafting.

In shops, factories and other plants where a large amount of shafting is used for the transmission of power to the various machines, it is very important that all of the shafting should be kept in perfect alignment, for if allowed to run otherwise much power may be wasted. It has been demonstrated that shafting allowed to run out of line may cause a waste of as much as forty per cent. in power, the loss varying, of course, according to the condition of the shafting. Much loss of power may also be occasioned by belts which are too tight, and by improperly fitted or insecurely supported bearings. All couplings and shaftings should be inspected at regular intervals, and where a fault is found it should be remedied at once. The time and expense incurred in such inspection will be paid for by the saving of power and the consequent saving of expense in producing that power. Pulleys should not be placed too far from the shaft hangers. It springs the shaft, causing a waste of power, if it does not heat the journals. Small pulleys are a detriment whenever used; they cause a loss of power on account of the belt usually having to be strained very tight.

If for any reason it is necessary to change the direction of rotation of an alternator, the commutator should be loosened on the shaft, disconnected from the armature, turned half-way around on the shaft, tightened and reconnected. The brushes should be taken off, reversed and replaced on the studs.

ARRANGEMENT OF BOILER CONNECTIONS

By E. H. Naylor.

About two years ago, I had two 6-feet horizontal return tubular boilers to install, and the plant to change over in general, and the question in my mind was which was the proper way to connect my boilers and give the best results under the conditions that existed.

The new engine room was so situated that I wanted to take the steam from the front steam nozzles on the boilers as it was nearer the engine. My intention was to furnish steam to the main engine independent of all other places to be supplied, and as I was compelled to take the steam from the front and from the rear nozzles, I took the steam for the heating system, pumps and auxiliary engines.

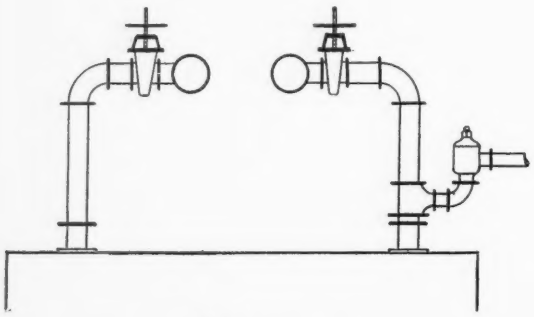


Fig. 1.

I placed my pop-safety valves on the rear nozzles, as I did not want them on the front main for they might cause trouble if they should blow when the plant was in full operation. Fig. 1 shows how the boilers are connected to the front and rear steam nozzles. Owing to conditions that existed, I was also compelled to place them in the position as shown, toward the centre of the boiler.

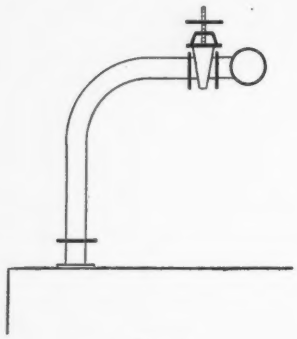


Fig. 4.

There were several suggestions offered by engineers but I decided to have it as shown in Fig. 1. One thought it would be a good plan to have the boilers connected as shown in Fig. 2 which would be a saving of labor and material. I could not agree with him because I do not believe in using angle valves on steam mains, as the substitution of an angle valve for an elbow is entirely wrong. A valve is made to stop the flow of water, steam or gas and not to act in the capacity of both valve and elbow combined and under the strain due to expansion and contraction a valve cannot remain in good condition and consequently must give trouble by not being steam tight. I believe this is one of the causes of leaky angle valves.

I consider Fig. 3 as poor a way, if not poorer, than Fig. 2.

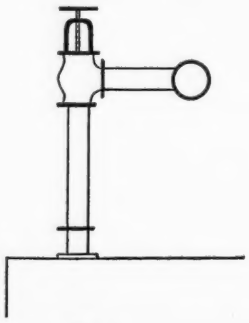


Fig. 2.

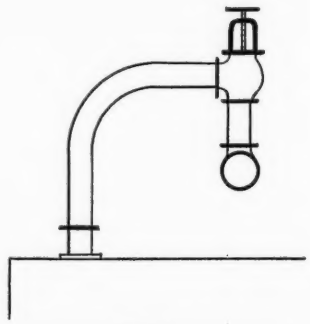


Fig. 3.

The results obtained in Fig. 1 cannot actually be realized in Figs. 2 and 3, for the location of the stop valves in Fig. 1 covers all practical points. Fig. 4 is one way I thought of quite strongly and I would have connected my boilers up in this way but was unable to secure the bends in time, so I had to use the long turn extra heavy elbow. Good results are obtained from Fig. 4, as no trouble will result from want of expansion or from condensation.

A good, practical way is shown in Fig. 5, for, with the valve in the centre, no water can collect. With the line of pipe, as shown in Fig. 6, the placing of a valve at *a*, *b*, *c* or *d* would not give as good results as when the valve is placed as shown in Fig. 5. Should the valve be placed at *a*, the pipe must fill with water up to *b* and it would be dangerous to open this valve and allow the water to pass into the main when the plant is in operation. If the valve be placed at *d* instead of at *a*, the steam in the main will condense in the riser to the point *c* if the valve was closed and the boiler cut out.

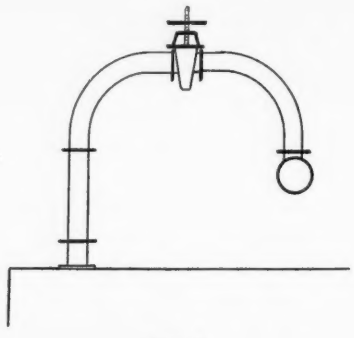


Fig. 5.

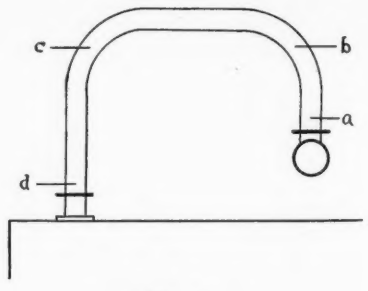


Fig. 6.

It might be suggested that two valves would be proper but if we put in two valves and one happens to leak we are just as

bad off as we were before. Without a doubt the proper remedy is to put the valve in the position shown in Fig. 5. Should we not do this, then the only remedy is to place bleeders just above the valves at *a* and *d*, which would have to be used before cutting in the boiler on the main.

Too much care cannot be taken on steam connections so that condensation is avoided and the proper expansion allowed for; if these things are not provided for, trouble must surely come sooner or later.

THE PRINCIPLES OF ICE MANUFACTURE

The Can and Plate Systems of making Artifical Ice

The two general methods used in the manufacture of ice for commercial purposes are known as the can system and the plate system. In the can system the water is frozen on the inside of the can or "inwardly," retaining in the ice the air and all the impurities which the water contains. In the plate system, the water is frozen on the outside of the plates or "outwardly," excluding the air and impurities from the ice into the unfrozen water around it.

In the dry plate system, the ammonia coil is clamped between two plates, no brine being used. The ice is formed on the plates with circulation, de-aeration and constant filtration of the freezing water. The ice is loosened by admitting hot ammonia gas into the coil. Harvesting is performed by removing the plates of ice with a crane and cutting it into cakes with a steam cutter. The block system is the same as the dry plate system except that no plates are used, the ice forming

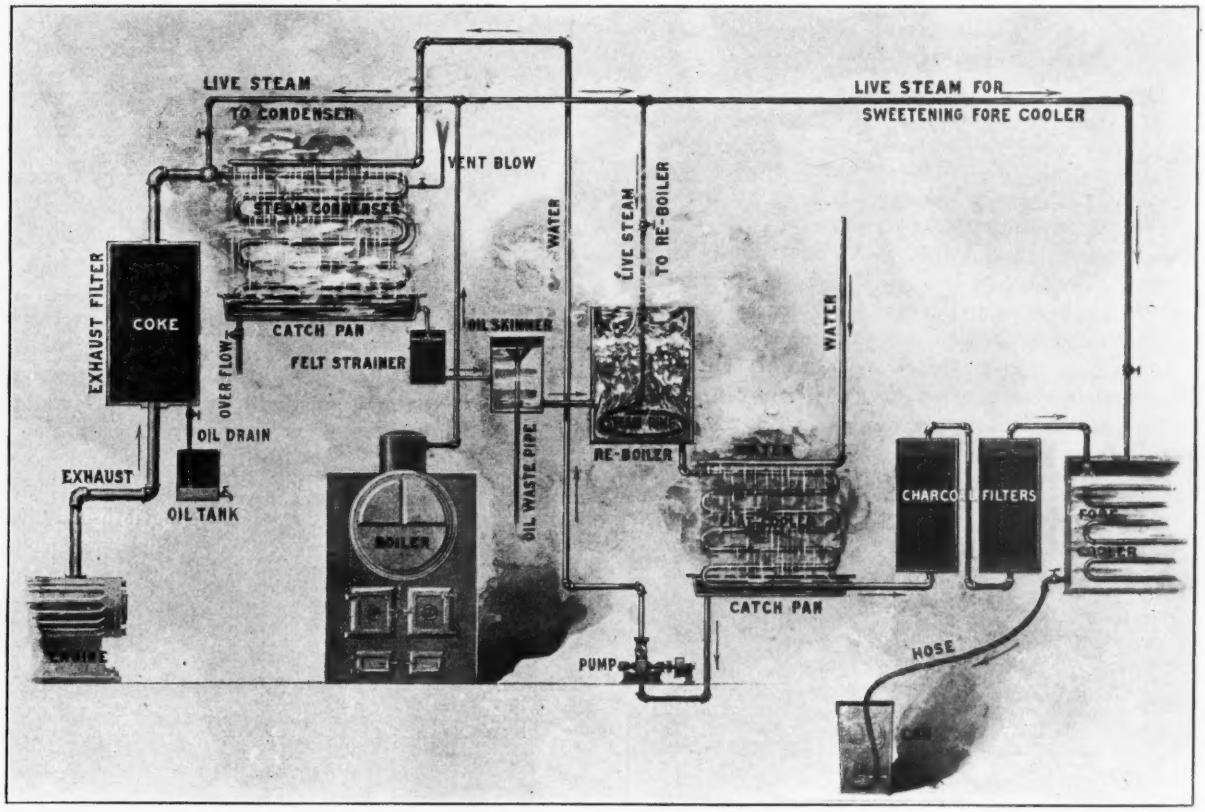


Diagram of Apparatus for Distilling Water from Engine Exhaust for a Can Plant

Can systems have many modifications, and are alike in all the important principles, but plate systems may be divided into three distinct types: the brine plate system, the dry plate system and the block system.

In the brine plate system, the ammonia coil is submerged in brine between two plates a few inches apart. The ice is frozen on the outside of the plates without circulation of the freezing water, freedom from air being secured by slow freezing and the ice is cleaved from the plates by removing the cold brine and admitting air or warm brine. Harvesting is performed by removing the plates of ice with a crane and sawing into cakes.

directly on the ammonia coils, from which it is harvested by cutting off the blocks with a steam cutter.

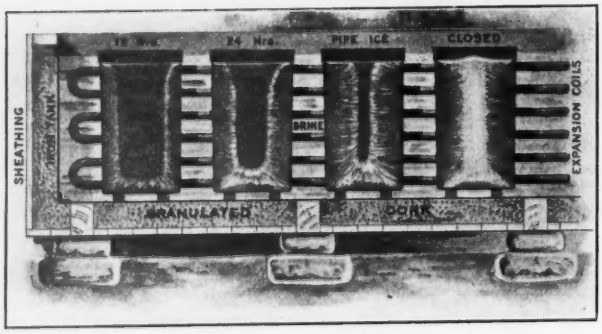
The can system involves the refrigeration of the brine by means of ammonia coils to a temperature of 12 degrees to 20 degrees above zero. Cans of galvanized iron containing the water to be frozen are immersed in a tank of iron or wood containing the brine. The ice forms inside on the walls of the cans and as the process is continued becomes thicker until a solid block of ice is produced. Freezing usually takes place in about forty-eight hours and when completed, the cans are

removed and the ice detached either by dipping the can in warm water or by sprinkling it. The cans are shaped with tapering walls, narrower at the bottom than at the top, so that when the ice is freed from the walls of the can, it can readily be dropped out. The process is that of "inward" freezing, as shown in the accompanying illustration, the cake gradually closing and pushing the air and impurities to the centre where they finally remain, forming the core.

When natural water is used in the can system, the ice formed is white and looks like marble and is called for that reason "tombstone" ice. While this form of ice can be used for packing purposes, it is not generally a marketable product, so that means must be taken to purify the water and expel the air. While there have been several methods used for doing this, the only commercial method is to condense the steam from the engine, for which purpose an ample supply of water is necessary and then by means of filters, the engine oil and other foreign matter must be removed.

The accompanying illustration represents a diagram of the general type of apparatus for distilling water from the engine exhaust for a can plant. The process may briefly be described as follows: The exhaust steam from the engine passes through the exhaust pipe directly to a purifier or steam filter and thence to a condenser. After being condensed, it goes to the reboiler where the water is reboiled by means of heat from live steam coils. By this process, the impurities are driven to the top and the air is removed. The scum is removed from the top by means of a skimmer. The water to be used for ice is drawn from the bottom and passes through another filter or deodorizer after being cooled. It then goes into a storage tank from which it is supplied to the cans for freezing. Live steam is also admitted to the storage tank for the purpose of sweetening the water.

With the plate system, pure transparent ice can be made from potable water taken from the usual sources of supply or it can be thoroughly filtered and subjected to special treatment if necessary. In this system of ice freezing, as shown

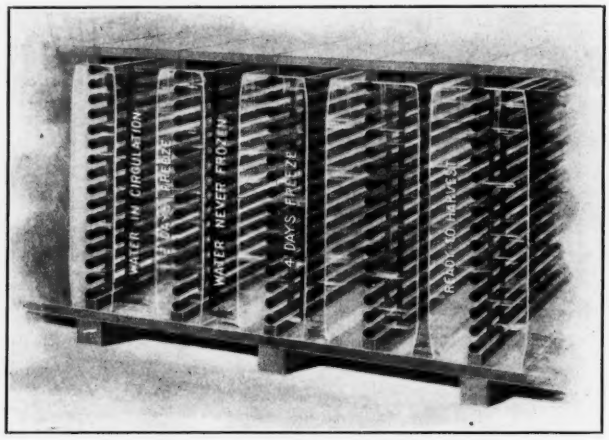


Inward Freezing of Can Ice

in accompanying illustration, the impurities are forced out of the water in the process of freezing, and are found as a precipitate at the bottom of the compartment in which the ice is frozen. This may be thoroughly cleaned out by washing before a fresh supply of water is run in for freezing.

Since in the plate system no distilled water is used for freezing, the water evaporated by the boilers may be reduced to only that necessary to drive the steam engine and auxiliaries and hence steam may be used expansively in any of the machines desired. In the plate system, the ice gradually forms, in from eight to ten days, to a thickness of about 14 inches on the hollow plates which are usually 10 x 14 feet or 8 x 16 feet in area.

In the can system, the water is frozen in blocks weighing 200, 300 or 400 pounds, depending upon the design of the plant, the freezing being completed in about 48 hours. The freezing tank area occupied by the plate system is therefore



Outward Freezing of Plate Ice

about twelve times as much as that required by the can system and the cubical contents four times as much. One advantage of the plate system is the fact that practically clear and transparent ice is produced without any special apparatus and its chief disadvantage is the fact that in the nature of the process, the building up of the ice is slow and expensive and for continual operation, several tanks are required so that one or more may be frozen while the others are being emptied. With the can system, a practically continuous process of making ice can be maintained.

The cost of the plate system is about one-third more than that of a can system. In the latter system, ice is being drawn throughout the 24 hours, and the hoisting is usually done by hand tackle. In the plate system, the whole product is harvested, cut and stored in a few hours, the hoisting usually being performed by power.

Thickness of Boiler Iron Required, and Pressures Allowed, by the Laws of the United States.

PRESSURE EQUIVALENT TO THE STANDARD FOR A BOILER FORTY-TWO INCHES IN DIAMETER AND ONE-QUARTER INCH THICK.

Thickness in Sixteenths	Diameter.						
	34 Inches.	36 Inches.	38 Inches.	40 Inches.	42 Inches.	44 Inches.	46 Inches.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
5	169.9	160.4	152.0	144.4	137.5	131.2	125.5
4½	158.5	149.7	141.8	134.7	128.3	122.5	117.2
4¼	147.2	139.1	131.8	125.1	119.2	113.7	108.8
4	135.9	128.3	121.6	115.5	110.0	105.0	100.0
3⅔	124.5	117.6	111.4	105.9	100.8	96.2	92.0
3⅓	113.2	106 9	101.3	96.2	91.7	87.5	83.0
3	101.9	96.2	91.2	82.6	82.5	78.7	75.0

THE BOILER EXPLOSION AT BROCKTON, MASS.

Some Details of the Accident which Wiped the Grover Shoe Factory Out of Existence

In our last issue, mention was made of the disastrous boiler explosion which occurred on Monday morning, March 20th, at Brockton, Mass., which entirely wrecked the large shoe factory of R. B. Grover & Co., and caused the death of 63 employees and the injury of 42 others. The explosion took place about 8 o'clock in the morning just as the factory employees were beginning work for the day and in one short hour all that remained of the once bustling shoe factory was the chimney, which remained standing as a monument of one of the most terrible boiler explosions that has ever taken place. We are now able to show the photographs and give a more detailed description of the accident.

The plant consisted of two horizontal return tubular boilers, one boiler being a comparatively new one, and was used most of the time, while the exploded boiler, which was 72 inches in diameter and 16 feet long, was used only to allow for inspection, cleaning and repairs, and up to the morning of the accident had not been in use for several months. It was built in 1891 and had 140 3-inch tubes, the shell being of soft steel 3/8-inch thick. The lap joints were double riveted and the boiler was braced with radial braces. The boiler consisted of four sheets.

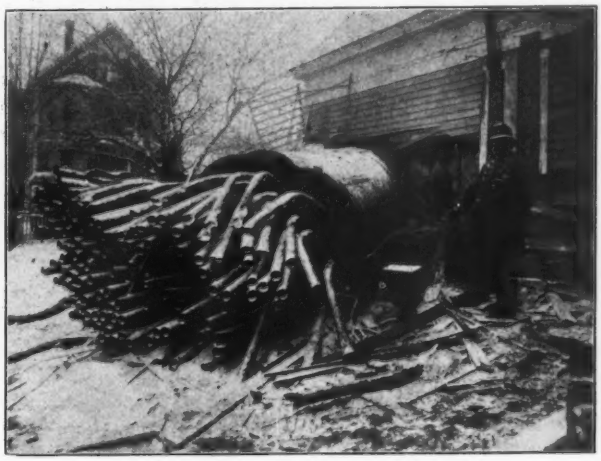
When the boiler exploded, the rear sheet was completely separated at the rear girth seam, shearing quite a number of the rivets, while quite a few showed very plainly that they snapped off as short as pipe stems and that they were crystallized. It is claimed, however, that the result of the explosion was due to a flaw in the upper side of the under lap which was

View taken from the spot where the old boiler stood

in such a position that it was impossible for the inspector on previous occasions to see or in any way discover it.

The rear sheet, which was separated from the boiler, was found in the boiler house near where the boiler had been, and from the force of the explosion was flattened out as straight as the day it came from the rolls. The tubes all let go from the rear head and all remained intact in the front head.

The main portion of the boiler was hurled north, in which direction it faced, a distance of 212 feet, and passed through the top of the engineer's house, which was situated about 100 feet from the boiler house, wrecking a portion of it, and struck another house, which stopped the flight of the boiler, but, in doing so, it was moved about 18 inches off its foundation, crushing in one side.



Where the Boiler ended its flight

The engineer, David Rockwell, was killed instantly by the explosion. When found, his body was badly charred and his head was gone, as were also both hands and one foot, but the chair, upon which he was seen sitting just previous to the explosion, was found in good condition.

The principal loss of life took place in the two wings of the factory building which enclosed the boiler house on two sides. These L-shaped wings were five stories in height and were composed of wood. As a result of the explosion, a portion of the factory collapsed and the mass of heavy timbers and machinery caught many of the employees and penned them in and when the building caught on fire, which it did immediately after the explosion, they were roasted to death and it was due to this combination of circumstances that the list of fatalities was so large.

The scenes of horror which took place while the building was burning were terrible. From out of the flames came the wild cries of the burned and the dying, and the distorted faces of the injured as they looked through the flames for help will never be forgotten by those who saw them. The flames from the burning factory soon spread to the surrounding buildings and a fire of large magnitude was the result.

The inquest to determine the cause of the accident was held on the 29th of March and the investigation was awaited with much interest. The public was not admitted and but few of the press. The affair was hushed up as much as possible, only half the witnesses being examined. The press did not give out what the State reported.

After examining some of the witnesses, the district attorney said: "Your Honor, so far as I can determine from the evi-

dence presented to me and to the court, if there is any one criminally liable for the explosion of this boiler, it is the man who invented the lap-seam boiler." "In that event, the case is beyond the jurisdiction of this court," said the learned judge, and thus the hearing was ended.

As reported by the newspapers, the bulk of the testimony offered was given by experts from various parts of New Eng-

View of New Boiler and Chimney ; all that is left of the once thriving Shoe Factory

land, and all went to show that the explosion was caused by a crack on the under side of the upper lap of the boiler, which in an inspection it was next to impossible to discover, and that such a crack was liable to exist at any and all times in boilers of the lap-seam type.

One of the expert witnesses was Edward Kendall, of Cambridge, a member of the Charles River Iron Works firm, which Company manufactured the boiler which exploded. Mr. Kendall testified he had been in the business of manufacturing boilers for the past fifty-seven years and his Company made the boiler in 1891 for the Grover Company. He described the boiler as a longitudinal lap-seam boiler, the shell of which was made of soft steel, which, later in the hearing, it was determined was made by the Carnegie-Phipps Company, Limited. The witness stated that the use of lap-seam boilers was constantly decreasing, and that his Company had not manufactured any for about ten years, giving way to the butt-strap-seam boiler because it was stronger and safer.

He was then asked if he had examined the boiler at the R. G. Grover shop since the explosion, and upon replying in the affirmative was asked to give his opinion as to the cause of the explosion. "In making a lap-seam boiler," said Mr. Kendall, "it is impossible to construct it absolutely on the line of a true circle, because there is always a variance where the lap is made and riveted. The normal pressure of this boiler was eighty pounds, and when this pressure was increased or decreased it had a tendency to expand and contract the boiler where the lap was made, which eventually cracked the plate at that point, and as the boiler continued in use this crack opened up until it could not stand the pressure put upon it. The crack made in this boiler, as I found by examining it, was started on the under side of the upper lap and might have been started for several years or might not have been started for more than a few months. In my opinion the crack was started in the middle of the sheet, and I do not think it could have been an original defect in the material."

The witness also stated that his Company had made repairs on the manhole of the boiler, but these repairs could in no way be connected with the explosion of the boiler because that portion of the boiler was yet intact. Following Mr. Kendall's testimony, Mr. C. O. Emerson, of the R. B. Grover firm, was called to the witness stand and gave evidence of minor importance regarding the purchasing of the boiler and the repairs which had been made upon it.

The next witness called was W. Henry Preston, an inspector of the Hartford Steam Boiler Inspection and Insurance Company. He stated he had been in the employ of this Company for twenty-three years and had personally inspected many times the boiler which exploded at the R. G. Grover factory. He stated the last time he inspected it was on December 28 last, and he gave a detailed account of the manner in which he inspected all boilers. He stated that the most reliable and common test used was to go all over the inside of a boiler, sounding the shell with a hammer for defects and relying upon this and the eye to detect fractures. He declared, as did experts who followed him, that it would be absolutely impossible to detect a fracture such as the Grover boiler sustained by the method of inspection which he described, and that he thought it very improbable there was any known test which would have been absolutely sure of showing it up. Following Mr. Preston, John F. Malloy, of Boston, and W. D. Eastman, of Rockland, both expert inspectors of the Mutual Steam Boiler Inspection Company, testified, following in nearly every particular that of Mr. Preston.

Charles S. Blake, of Hartford, Conn., general manager of the Hartford Steam Boiler Inspection and Insurance Company, next testified. He stated that lap-seam boilers were at all times dangerous, more so than the butt-strap-seam boilers, because of their construction. He stated although about 80 per cent. of the boilers in use in the country were lap-seam boilers,

Engineer's Rockwell's house damaged by Boiler in its flight

that in New England, which was the most progressive portion of the country along these lines, this percentage would be greatly reduced.

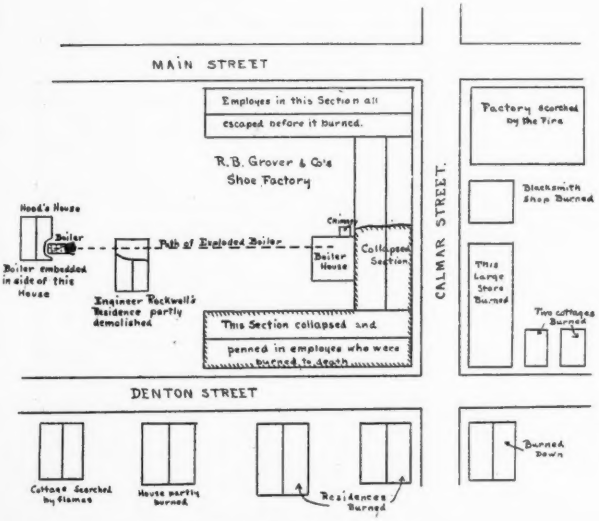
"I have no doubt," said Mr. Blake, "that this fracture was there at the time the last inspection was made, but there is no absolutely sure method of making a test which would have revealed it, and the only possibility would be the hydrostatic test,

which if made, might tend to open up just such a seam as was in this boiler, even if it did not exist at the time the test was made, and for this reason many owners do not care to have the test applied, inasmuch as it is not absolutely sure."

He testified he was present when the safety valve was removed by the State officials and that it was in good working order and that marks found on the shell of the boiler indicated the material came from the Carnegie-Phipps Company, Limited, which was assurance that it was of superior material.

The case was brought to a close by the testimony of John W. Newhall, the night watchman at the factory who started up the boiler; Engineer Gibbs, who was in the boiler room shortly before the explosion; Frederick Bird and Cheney Howland, both employees of the factory, who saw and talked with Engineer Rockwell a few minutes before the terrible accident.

All of them testified as to the reliable condition of Rockwell on the morning of the explosion and the first two named testified as to the condition of the boiler between the hours of



Plan of Demolished and Burned Area

7 and 8 o'clock. Mr. Newhall stated that according to instructions he started the fires under the boiler and left the place shortly after 7 o'clock, Monday morning, with Mr. Rockwell in charge. At that time there were two and one-half gauges of water in the boiler and the pumps were working. Mr. Gibbs stated that at 7.35 he was in the boiler room and saw 90 pounds of steam on, with the same amount of water in the boiler, and the pumps working and that while he was there Rockwell stopped the pumps. He testified he left the room about twelve minutes before 8 o'clock and had proceeded but a short distance before he heard the explosion.

This ended the testimony and so far as the public is concerned nothing has been published since which will throw any new light on the subject. The testimony of the State Board was not given out and the whole thing was closed up rather suddenly. Four days after the explosion, the boiler was moved to the City Hall yard, which is surrounded by a high board fence which allows no one to see or get near it. Before the boiler was moved, no one was allowed to get within 30 or 40 feet of it.

Suggestions for Starting Up an Ice Plant.

When packing the piston rod of the compressor, only the best and the exact size packing should be used. The ends of the packing should not overlap and the packing should be a snug fit before any pressure is put upon the stuffing-box gland. The oil hole should be examined before the packing is put in to be sure that it is not closed up, so that the rod can be amply lubricated.

The condenser should next be examined and inspected inside, to be sure that the pipes are clean and galvanized. If the pipes are not clean and galvanized, there is a chance for dirty ice. If the condenser is of the atmospheric type, it should be looked to that the sprinklers will all operate properly. From the condenser the distilled water flows by gravity to the tanks usually on the same floor with the compressors. In these tanks there is usually a float which is connected by means of levers and chains to the throttle valve of the pump. These floats should be examined for leaks and the whole throttling arrangement inspected.

The steam coil in the reboiler should be examined for leaks and the skimmer inspected. The only part of the skimmer likely to get out of order is the regulating device which regulates the height of water in it and allows the accumulated water in the skimmer to flow to the coolers. After the tank is empty, the regulating device should close and not open again until the water begins to flow through the overflow pipe to the drain which opens the valve again.

The coolers should be examined for leaks and cleanliness. They are very similar to a condenser with the hot distilled water flowing through the inside of the pipes and the cooling water on the outside. A steam connection, which is usually provided at both ends of the coils, should be used before starting up, as there is always more or less oily matter which escapes from the skimmer and adheres to the cool walls of the pipe. The steam jet blowing through it will loosen these particles and carry them out with it. At the same time this is done, the joints can be examined for leaks.

After being cooled, the distilled water goes to the filters. It is very important that these should be thoroughly cleaned or new charcoal used before using for the coming summer. If they have not been used much, a good cleaning will be sufficient but if they have had much service, it would be very much better to repack the filter with fresh charcoal as charcoal loses its efficiency after hard service. From the filters, the pure water goes to the storage tank or fore cooler. As this tank usually has a cooling coil near the bottom it is very important that at this stage no ammonia should be allowed to escape into the water. This can usually be determined by emptying the tank when either the smell will determine whether there is a leak or the burning sulphur test may be used. From the fore-cooler, the distilled water goes to the can-filling device, which should be examined, and if that is all right, the freezing part of the system can be taken up.

The freezing system must be tested so that it will hold the test pressure for 24 hours without leaking. This is usually done by admitting compressed air into the system. If the plant is provided with an air compressor, this can be used for the test but, if not, then with the aid of the by-pass valves with which every compressor is equipped, the usual operation of compressing the ammonia can be reversed. On account of

the comparatively small size of the by-pass valves, the machine should be run very slowly and before the air test is begun, all the coils should be blown out with the compressed air.

During the blowing out of the coils, bad leaks can be found so that they can be repaired before the air test begins. After it has been ascertained that the valve stems are well packed, the compressor should be run until a pressure of about 175 pounds has been attained. The return and expansion valves should all be open so that the required pressure will reach all parts of the system.

When the required pressure has been attained, the machine should be stopped and the pressure gauge noted. It will first fall slightly, due to the cooling of the air in the system, but after the initial reduction, it should remain steady if there are no leaks. If there are leaks in the system, the pressure gauge will, of course, fall in proportion to the size and number of leaks. Leaks can best be found by covering all joints or parts which are thought to leak with strong soapy water and if there are any leaks, the escaping air will form bubbles in the soapy water at the leak, thus clearly locating it.

If there are any leaks they should be repaired and the process repeated until it is found that the air will remain in the system for a long period of time without any appreciable reduction in the pressure. The vacuum test should then be applied after the compressed air has been blown out of the system. This is done by running the compressor slowly with the suction stop valve on the compressor and purge valve on the top of the compressor open until the gauge shows a vacuum. Then stop the machine and close the suction stop valves and the purge valves.

The effect of the vacuum test will often be to dislodge small particles of dirt which were held in place by the compressed air something like a plug and while the pipe or joint showed tight when pressure was applied, it will show a leak under a vacuum. When the vacuum fails to hold, it will be necessary to again test the system with compressed air and determine by the soapy water test where the leak is. If upon the repair of that leak the pressure holds for 24 hours, the system will be ready for charging with ammonia after the air has been thoroughly expelled from the system.

As it is impossible to eject all the air from the plant by means of the compressor, it is advisable to insert the charge of ammonia gradually and permit the air still remaining in the system to escape through the purge cocks with as little loss of gas as possible.

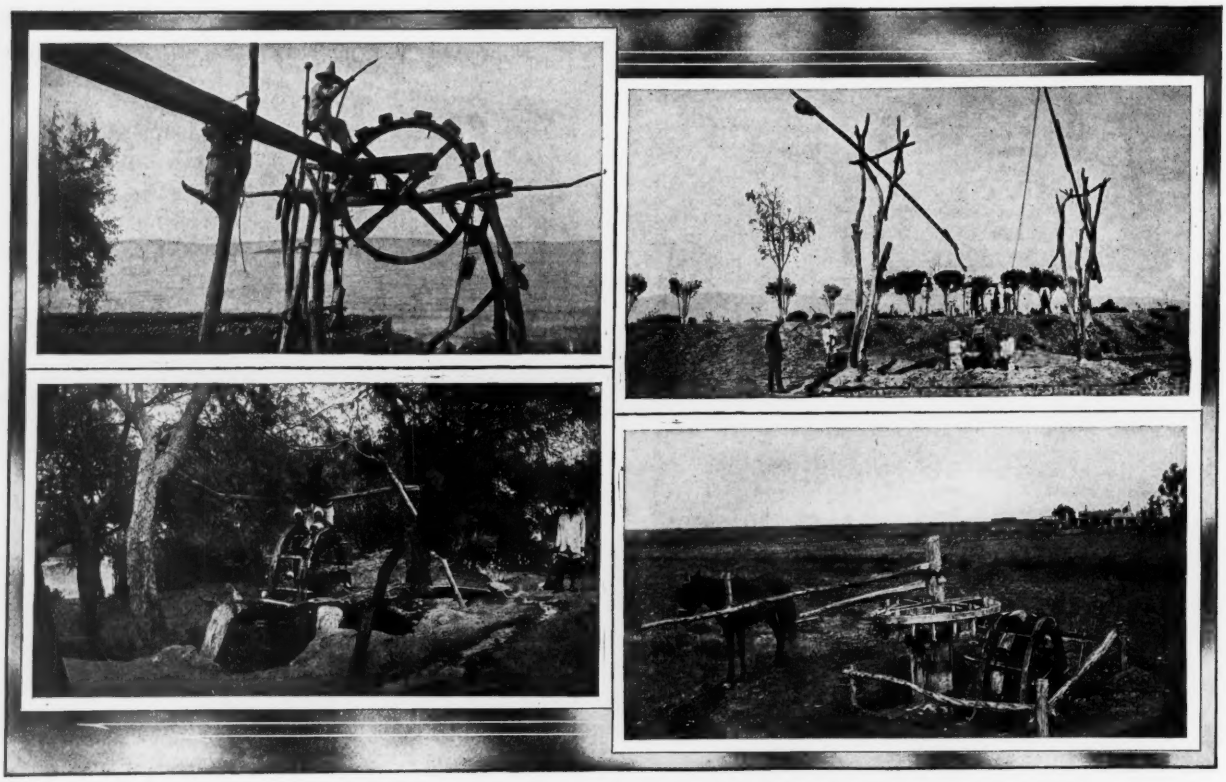
(To be continued.)

Mexican Pumping Engines.

The accompanying photographs were taken in Southern Mexico and illustrate the methods in general use there for elevating water. As the patents on these devices have no doubt long since expired, the public may feel perfectly safe in adapting them if convenient.

It will be noticed that even with these crude pumps the question of efficiency comes very close home, not along the line of fuel consumption but, as is shown in the two left-hand photographs, it is rather a matter of "feet" consumption. That is, while in the upper left-hand illustration it can be seen that one man is keeping the pump going with his "shirt on," in the lower illustration it will be noticed that it requires two men to keep the pump going with their shirts off, thus showing an efficiency of 100 per cent. or "two feet" in favor of the upper pump.

It is interesting to know that these ancient devices are being



Methods in General Use for Elevating Water in Mexico

rapidly replaced by more effective machines of modern type and that irrigation pumps of the new turbine pattern are coming into very extensive use in Mexico, where power is cheaply developed by utilizing the many mountain streams for generating electric current, and then distributing it over the vast agricultural areas lying between the mountain chains. The above photographs were lent to us by Henry R. Worthington, 114 Liberty Street, New York City.

Mercury Vapor Converter.

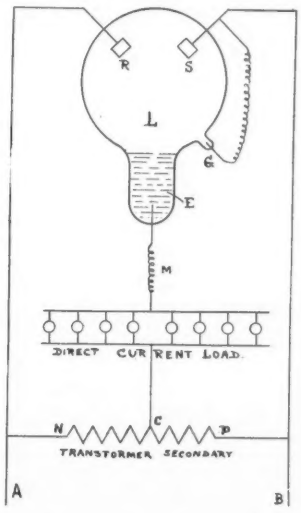
At a recent meeting of the Engineers' Club of Philadelphia, F. H. von Keller read a paper on the "Principles and Applications of Mercury Vapor Apparatus" in which he described the mercury lamp, the mercury vapor converter and the mercury vapor interrupter. The most interesting part of the paper was a description of the mercury vapor converter, a sketch of which is shown in the accompanying illustration.

A converter in general is a piece of apparatus or machine by means of which alternating and direct currents are converted into each other. As usually applied, alternating current of high voltage is converted in direct current of low voltage. It is used chiefly in connection with alternating current circuits, where the application of alternating current is impossible, such as for charging storage batteries or where the direct current is more suitable than alternating current, such as for running elevators or hoisting motors or street car motors.

Since the transmission of alternating current is very much more economical than the transmission of direct currents, and since only direct current is suitable for many purposes, it will often be advantageous to be able to obtain direct current from alternating. At the present time, all alternating currents are transformed into direct currents by means of a "rotary converter" which is a machine very similar to a generator, with one field and one armature, the latter being designed with a direct current commutator and alternating current slip rings. They are usually quite large and expensive and are not particularly efficient.

The mercury vapor converter described by Mr. von Keller was designed to replace the rotary converter. As shown in the accompanying diagram, it consists of a large glass bulb or globe, L, which contains a perfect vacuum, a small puddle of mercury, E, at the bottom, constituting the negative electrode, and two electrodes of iron, R and S, at the top. Platinum wires run from the electrodes to the outside wires. For starting the converter there is a projection G, connected by a wire resistance to one of the alternating current mains. A and B are the alternating current mains, which are connected across with an inductive resistance, such as a transformer secondary. M is a choke coil placed in series with the converter so that the current will lag behind the electro-motive force and keep it in operation when the alternating current passes through zero.

The operation of the converter is as follows: Suppose at one instant the main B is going through that portion of its wave which is positive and the bulb L filled with highly heated mercury vapor, then current will flow through electrode, S, through the lamp, and choke coil to the middle point C of the transformer and back through line A. As the electro-motive force drops to zero, the current has not yet reached zero as it lags behind. The converter does not go out at this instant but would a little later when the current finally did reach the zero point; but the electro-motive force between the terminals P and C, which is exactly opposite to that between N and C, is trying to force current from electrode E to electrode R and on account of the lag of the current from R, it will pick up this current before it again becomes zero and maintain it through the rest of the alternation, until this electro-motive force again approaches zero. Again, since the current is lagging behind, the electro-motive force between N and C will pick it up from P and C before it actually becomes zero, preventing the converter from stopping and so on. The introduction of the choke-



Mercury Vapor Converter

coil M enables the apparatus when supplied by the proper electro-motive force from a single phase circuit to operate without the use of auxiliary direct current. On account of the choking power of the coil the arrangement gives a nearly steady current by connecting the direct current mains to the neutral point of the alternating supply.

It is necessary to provide some means of starting the converter, which is done by tilting the bulb so that the mercury flows into G and makes a connection across the terminals. This forms a circuit through the mercury and starts the mercury vaporizing, when the bulb can be swung to its vertical position.

Its particular advantage is supposed to be that it has no moving parts, consumes only 14 volts loss of potential in its operation and weighs only 8 pounds for every 1000 pounds of the rotary converter.

Largest Coal Sale on Record.

The largest sale of coal in the history of the coal industry was finally closed recently by President Francis L. Robbins, of the Pittsburg Coal Company, with the United States Steel Corporation. The contract calls for the entire coal supply needed by the Steel Corporation during the next twenty-five years. The Corporation uses from 5,000,000 to 8,000,000 tons per year. Assuming a yearly average of 7,000,000 tons per year, this sale is equivalent to 175,000,000 tons of coal before 1930. Loaded in 40-ton cars, this means 4,375,000 car loads, or if there are 50 cars in a train, it means 87,500 train loads, enough to go around the earth at the equator one and one-half times.

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The Brockton Boiler Explosion and the Lap-Seam Boiler.

Whenever there is a boiler explosion which causes loss of life, an inquest is held to determine the cause of the explosion. The most usual verdict rendered, especially when the unfortunate engineer or attendant has been killed, is that of negligence or low water. These verdicts are rendered usually for want of better reasons but in the case of the disastrous explosion at Brockton, Mass., described in another column of this issue, it is the first time on record that the inventor of the lap-seam steam boiler, whoever he may be, was ever blamed for an explosion of that kind of boiler.

If the loss of life in this explosion was not so serious, the verdict would no doubt cause a smile upon the countenance of every person interested in the science of engineering. If the engine in that same factory had run away and the fly wheel had burst, causing the same damage, would the verdict have blamed James Watt because he invented the steam engine? Or, suppose the I-beams in the building gave way under the strain and caused the building to collapse, would the verdict have been rendered against the unknown inventor of the I-beam?

It is said upon investigation that the explosion was caused by a crack on the under side of the upper lap of the boiler, which in an inspection it was next to impossible to discover. Then why not have brought in a verdict of that kind, which would have had at least the respect of the thinking public?

Considering the prominence which this explosion had attained, on account of its almost unparalleled list of fatalities, it is unfortunate that the inquest was held privately and everything hushed up as much as possible. It was due to the surviving members of the fifty or more families who suffered bereavement that the exact cause of the accident should be openly investigated and the blame, if there was any, laid at the feet of those to whom it belonged.

As the testimony of experts seems to show, however, there was absolutely no one to blame for the disaster. The boiler had been regularly inspected and as some of the witnesses were in the boiler room a short time before the explosion, it was known that the dead engineer had the proper amount of water in his boiler. The inspection of the safety valve after the explosion showed that it was in good condition, so that the engineer could not be blamed for the explosion. The boiler plate was also probably of the standard tensile strength and ductility as it bore the name of well-known manufacturers; so that the type of boiler was the only thing left to condemn.

Considering the fact that about 80 per cent. of the boilers are of the lap-seam construction, according to Charles S. Blake, General Manager of the Hartford Steam Boiler Inspection and Insurance Co., it seems to be a pretty late day to render a verdict against the inventor of this type of boiler.

—o—

Paralleling of Alternators.

When two alternators operate in parallel, they should each carry an amount of load proportionate to the power received from their prime mover and they will do so if they are run at such speeds as will give the exact frequency. If, however, the prime mover tends to produce a lower frequency than that running the other, the machines cannot carry equal loads. If an engine or water wheel governs in such a manner as to give more power than the other machines, this machine must carry more load, no matter what the field excitation may be.

This problem becomes more complicated when there are a number of power stations operated in parallel, especially when some are driven by steam and some by water power. In every steam or water power plant there is a certain time limit between the variation of the load and the application of the power to meet it, which depends upon the design of the governor, the inertia of the moving parts and the inertia of the steam or water which runs the prime mover.

In small plants where variable loads have to be met, good speed regulation is hard to obtain with the best of governing arrangements, but in large stations, no change in speed can occur with a variation of load unless the speed of every gen erator, motor and every piece of apparatus on the system changes, so that the speed of the system depends to a large extent upon total variations of the load rather than upon small ones.

It has been found that owing to the different conditions in volved in governing a mixed steam and water power plant, if the governors on all the machines are set to the same degree of sensitiveness, any increase in load will first be taken up by the steam plant, next by water plants which operate with impulse wheels, next by turbine plants which have short pipes and large forebay and last by either impulse or reaction turbines which operate with long lengths of pipes.

Since it is impossible to adjust the governors of each of the units to the time limit of the slowest plant, it is usual to select one plant, preferably one of the largest steam or water plants, to govern the system. When a steam plant is connected in parallel with a water power plant, it is usual to add an adjustable dash pot on the governor to make the action slow.

In all of these cases, high speeds are more desirable than low speeds and low frequencies present less difficulties than high. The desirability of high speeds with direct coupled alternators is very evident, as an increase in speed will bring about a reduction of the angular error introduced by a change of speed. Large fly wheels also tend to prevent fluctuations and, in general, whatever increases the inertia of the system will steady it. When the fly-wheel effect is insufficient, the frequency will fluctuate and this fluctuation may cause serious trouble if synchronous motors or rotary converters are connected to the circuit.

When operating with other kinds of prime movers, on account of its uniform rotative velocity and its relatively large fly-wheel capacity, the turbo-generator is said to be particularly suitable, especially for operating rotary converter systems. When run in parallel with reciprocating engines the steam turbine can be adjusted so that it will take the variations in the load, thus allowing the reciprocating engines to work under a more steady load. In this case it has the same effect as a regulator or storage battery on the system.

There seems to be no doubt that the introduction of a swiftly revolving turbo-generator with a sensitive governor will go far toward solving the difficulty of running a number of alternators in parallel in a composite plant.

The Expansion Line and the Hyperbolic Curve.

The value of comparing the expansion line on an indicator diagram with the true hyperbolic curve is often overestimated. An engineer will often take a series of cards and faithfully plot the hyperbolic curve on each of them and try to deduce some facts from the results. If the actual and the theoretical curves coincide, which they very seldom do, it is very probable that the engineer will feel cause for congratulation or when it is found that when, from some point on the expansion line near the point of cut-off, the hyperbolic curve is drawn and is found to fall below the expansion line, there is apt to be grave apprehension that something is wrong with the engine.

There is cause for neither congratulation nor apprehension if either of these conditions is met with. In the first case, the expansion line may coincide with the hyperbolic curve and yet it is very probable that both the piston and the valves may be leaky and the engine not working under economical conditions. On the other hand, it may be that the expansion line of the diagram diverges from the theoretical expansion line and yet the engine will be found working in the best of condition.

For the designing engineer or when compounding cards from a multiple cylinder engine, the plotting of the hyperbolic curve will often give results which are instructive, but with a single cylinder engine, the information which it gives is negative rather than positive.

The principal reason for this is due to our old friends, cylinder condensation and re-evaporation, which in turn depend upon the quality of the live steam, the ratio of expansion and the method of jacketing the cylinder. If there is a large amount of initial condensation there will probably be a corresponding amount of cylinder evaporation, which will bring the expansion curve above the true hyperbolic curve. With a large ratio of expansion, if the cylinder is well jacketed, there is likely to be more re-evaporation with the same result. If, however, there is much radiation from the cylinder, the constant condensation may be enough to overcome any re-evaporation due to expansion or heat from the cylinder walls and in a cylinder which is not jacketed in any way it is very probable that the expansion curve would fall below the hyperbolic curve; the hyperbolic curve in all this discussion being drawn from some point on the expansion curve near cut-off.

Leaky admission valves, leaky exhaust valves or a leaky piston may alter the pressure in the cylinder during expansion so that the expansion curve may follow the theoretical expansion curve or it may differ widely from it, showing that an abstract comparison will not give the engineer much information.

Instead of referring to the hyperbolic curve, it would be very much better, if possible, when the engine is new, to take a series of indicator cards at different loads and steam pressures and keep them for reference. This will then give a series of expansion lines with which other cards can be compared and if the piston or valves are leaky, a comparison with the expansion line when the engine was new will show it.

In all motor dynamos, having a field magnet common to both armatures, the ratio of transformation, neglecting the armature drop, is constant, no matter how the field excitation is varied.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Steam Pump Troubles and Their Remedies.

EDITOR THE PRACTICAL ENGINEER:

Of all the machinery that goes toward making a complete power plant, there is none so little understood as the steam pump. Half the time it is located in some dark, dirty corner, seldom oiled or cleaned; it is a faithful and uncomplaining servant, abused and neglected, yet one of the most important factors of the steam plant. After a year or so of faithful service, some day it fails in its functions; what a fuss is then made about the useful neglected servant. Then the repair man is sent for but, as the cause is usually very trifling, he keeps to himself the cause of the trouble.

In this connection, I would like to give a few experiences I have met with. I was called to look at a duplex steam pump that was running at a terrific speed so as to keep water in sight in the boilers but the boss would not allow us to touch the pump until the maker's repair man came. This man said the pump was all right but the packing in water pistons was not the proper sort. He repacked the pistons with proper packing but if anything, the pump was worse than before. The pump was pulled apart but everything was found all right. Upon investigation we found the feed-water heater was leaking. There was nothing wrong with the pump.

On another occasion, a steam pump was short-stroking with a hard knock on the steam end. The engineer told me he had taken all the covers off but could not find anything wrong. However, I took the cylinder cover off and disconnected pistons, took them out, put my hand to the front end and pulled out several pieces of castings that had broken off between the ports and dropped down in front of the piston. The pump, after being put together, worked nicely.

On still another occasion, a new pump was being installed and the firm, who bought it, were going to connect it up and start it themselves. The pump was started and proved to be a failure. I went at the pump and found that there were no rings on the steam pistons. When I went to the pump agents they discovered that this pump had been robbed to repair another and the rings had never been put back again. I got a set of rings, put them on and the pump worked satisfactorily.

I have seen trouble also with a power pump of the single plunger type. Every time the plunger thrust down, all the water pipes in the building got an awful jar. The trouble was simple; some of the packing had been carried through the pipe and lodged in the boiler check valve. When this was cleared, there was no more trouble.

A good way I have always found to give a fair idea when water pistons need packing is to close the discharge valve about three-quarter way. If the pump works freely, fresh packing would be a welcome factor.

In trying to find trouble in steam pumps, it has always been my experience that, if on giving steam it moves all right, then it is plain that the trouble is in the water end, but if the pump fails to move, the trouble is in the steam end. Small trifling things make many trying times for the engineer but a great many troubles can be avoided by using some oil and piping to suit connections on pump. My motto always is: "What man has done, man can do."

Phila., Pa. A BROKEN VALVE STEM.

Hot Bearings and Their Treatment.

EDITOR THE PRACTICAL ENGINEER:

In the March number, Mr. Maurice W. Campbell calls me down because I did not write my article on "Hot Bearings" as he wrote his letter. If he will read my article carefully he will see that the question is not how to prevent the bearings from heating but what was the cause of its heating. I gave a number of the probable or possible causes which would bring about the condition mentioned and also gave several simple remedies condensed to a few words. If I had explained at length how to remedy all the different causes which are possible, the article would have been long enough to fill this paper from cover to cover. If he will read his own letter over, he will notice that I mention among a number of troubles, the very same things that he thinks might be the trouble; namely, worn boxes and engine out of alignment. I also drew attention to the oil question several times. Almost any engineer when he finds out the trouble will soon find a remedy.

In the last paragraph of Mr. Campbell's letter, he advises taking out the bottom shell and recutting the oil ways if his preceding advice failed to cure the trouble, but suppose that the area of the wearing surface is insufficient, then his instructions would be of no use. I think I mentioned most of the probable causes of hot bearings in my short article and gave only an emergency hint or two as to their care when running. And now, Mr. Campbell, how many engineers have you met in your travels who have a micrometer in their kit? I think I can safely say that 75 per cent. of the stationary engineers depend on inside and outside callipers for all their fine work.

Toronto, Canada. JAMES E. NOBLE.

Points Relating to Steam Blowers.

EDITOR THE PRACTICAL ENGINEER:

As I have had some experience with steam blowers for the past few years under boilers that I have had charge of, it might be interesting to explain some of their features.

The blowers were placed so as to blow into the ash pits under the grates with the ash pit doors made as near tight as possible. Steam pipe of required size was connected to the blowers and a lever valve was put in the pipe close to where it takes steam from the main pipe. The flue damper was disconnected from the damper regulator and the lever valve, which is the main valve for the blowers, was connected to it, thus allowing the regulator to operate the blowers instead of the flue damper. The chain from the flue damper was brought down to the floor level so that it could be operated by hand at leisure.

This plant was burning bituminous coal up to the time the blowers were installed but then we changed to No. 3 buckwheat. The plant was worked its limit and was burning about 15 tons of bituminous coal in 24 hours under natural draught. With buckwheat, using the blowers, about 22 tons were consumed, but when the firemen became accustomed to it, they did not burn so much. Bituminous coal costs about $2.00 more per ton than buckwheat in this part of the country but the blowers with the buckwheat coal showed marked economy over natural draught with bituminous coal.

While these blowers were economical, there are some points that should be observed. There should be a valve above each blower where it can be handled conveniently by the attendant independent from the main valve so that when the ashes are being taken out or when cleaning fires, the blower can be shut off from that boiler during the operation and will not affect the others if there should be a battery.

It is very important to have blowers that are large enough. I have found in my experience that if the blowers are only large enough to give the required amount of air at the boiler pressure with the valves wide open, when the pressure on the boilers goes down so will the pressure on the blowers, and if the plant fires hard it will be quite a task to get it back. Also, when the fires get thick, it will be harder for the air to get through the ashes which have accumulated on the grate and consequently the fires will have to be cleaned oftener if stationary grates are used. Shaking grates are the best for this kind of fuel.

The blowers should be large enough so that the valve above them need not be open over a quarter of a turn; then, if the load should come on suddenly and the boiler pressure drop 5 or 10 pounds, the valves could be opened, thus forcing the fires to meet it. The lever valve which is attached to the regulator should be wide open all the time except when the regulator closes it.

The flue damper should be open just enough to carry away the gases. A simple way of telling is to close it enough to allow the flame and gases to protrude through the peep holes and joints of the furnace door; then open damper gradually until the flame just stops coming through. Once set, it will not have to be adjusted again unless run under natural draught. By having the damper partly closed in this way, the heat is confined to the boiler and setting under pressure, a good feature of which is that there will be no cold air rushing on the boiler when the furnace door is open.

New Haven, Conn. WM. F. BURDICK.

These Were Good Old Times.

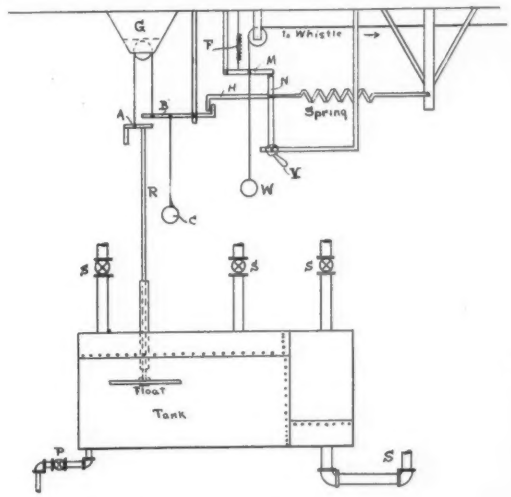
EDITOR THE PRACTICAL ENGINEER:

My first position as water tender in a steam plant was about 20 years ago and at that time steam plants were not so convenient as they are now; there being very few automatic stops and starters, which are now so common. This plant was in a sugar refinery and consisted of six return tubular boilers, two boiler feed pumps, one injector, two engines and one receiving tank. It was the duty of the water tender to look after the boiler, feed pumps, injector and receiving tank. To make this position all the more desirable, the pumps were placed in separate rooms and the receiving tank some distance from the boilers and to still help the water tender and fireman, the superintendent agreed to furnish steam for a confectioner.

There were two firemen on watch and our hours were the old kind; get up and go to work and as soon as working hours were over it was time to go to bed. Those that have had experience in a sugar refinery in those olden times can realize the changes that have taken place since.

Our receiving tank was always a source of trouble to us. All the returns entered it and at times the tank would be flooded and the water would run out over the floor. At other times, the tank would be empty and then air would rush into the suction pipe of the pump. We drafted our water from a river, the suction pipe to which branched off to the receiving tank so that the valve leading to the receiving tank could be partly closed or the pipe from the river could be partly closed, depending upon the amount of water needed in the system to keep up the water level in the boilers.

In those days high and low water alarms and other inventions that every plant of ordinary size is now equipped with were few and the engineer and firemen had to get along in the good old way by operating all parts by hand wheels or levers.



Home-Made High and Low Water Alarm

I came to the decision of making a high and low water alarm that would work automatically and save many steps besides preventing the tank from flooding the floor or becoming empty. The operation of the device is as follows: Water enters the tank through the four pipes marked S, and as it accumulates it raises the float until the end of the rod R comes under the lever B, raising it up and unlocking it from lever H, the spring pulling the lever from under the lever M allows the weight W to pull it down and blow the whistle. To reset it, the weight W is lifted upward by hand, the handle V is moved to the right and the small spring F pulls lever M upward. As soon as the levers are in place, the weight W is lowered until the pull comes on top of lever N as shown.

In case of low water, the same action takes place except that it is the cord which comes in action as the float drops. The cord, that is fastened to top of rod R at A and passes over pulley in bracket G, lifts lever B, unlocking it from lever H, when the whistle is blown as before. Thus in case of high or low water in the tank the water tender was notified that something was wrong and needed his attention.

This scheme saved lots of worry and was reliable. The superintendent thought this kink a good one and I was not sorry for the work I did on it.

Cambridge, Mass. W. A. D.

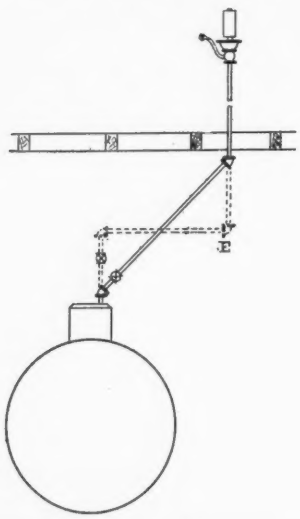
A "Squeaky" Whistle Remedy.

EDITOR THE PRACTICAL ENGINEER:

I would like to say a few words in regard to whistles that "squeak." The accompanying sketch will show how I stopped one whistle from "squeaking" in the plant where I am employed.

The boiler was located in the cellar directly under a machine so that the whistle pipe could not run straight up. The dotted line in the sketch shows the old method of piping which caused the "squeak."

To remedy the trouble, I took two 45-degree elbows and two nipples and constructed the piping so that no water could settle in it as shown. With the old system of piping, the water



"Squeaky" Whistle Remedy

settled in the corner E which made the whistle "squeak." I hope this may enable some other engineer, who has had a like trouble, to remedy the difficulty.

Shirley, Mass. H. N. B.

Rodney's Troubles.
Or Do We Need a License Law in Michigan?

(Rodney's Last Letter and Why.)

Mistur editur, mi deer sur, i hav bin so bizzy for the last munth leckshuneerin fur dad that i haint had time tu rite tu u til now. i tell u we fixd them and now dad is konstable and pound keeper and mi unkle lafe iz villidge president; and that haint all fur at last tusdays meeten ov the bord i waz appointed cheef of the orkners korners lecktrick lite and power kumpanys power house and all these fellars will say there iz nothin in havin a pull. it jist shows u that az soon az father got to be konstable he dug up a lot ov power sum way. I hav onli had the job a fu days but evvery thing iz runnin in good shape. I didn't fire enny ov the old hands fur twasnt good polisy to my way ov thinken. do u no mistur editur sum fellars iz nocken alreddy. 1 fellar told henry that ide make a good rubber stamp injinear, annuther sed ide be a good figger hed. now u kan just bet ure last penny that ile be the liveliest figger hed that evver waz seen around the corners.

ive sold mi thrasher outfit to lafe grabel and I won't have enny more trubbels to rite tu u about that. ile have no more frettin and studyin about what tu do and how tu du it but i want tu thank u fur the menny kind favurs you have dun fur me, and the menny tite plases u got me out ov tween henry and the othur cheef what waz at the power house. az fur henry he haz a good job tu since dad iz a konstable. he iz krossen tender fur the S. S. railrode up at the deepo. he watches the trains go bi and stops enny teems frum krossen the traks wen the injines are kummin.

i wont be abel tu rite tu u enny more mistur editur fur i am goen to git marryed. ime goen tu marry lafe wilsons widder. u remember me tellin u about the time he got hiz leg kut off with a mower. well he dide frum blud poisen, and i feal sorry fur amandy and the 4 kids so i jist up and askd her if shed kare to liv with me and she fell in a heep, so when ive got them kids to luk after and evvery thing at the power house i won't have enny time tu rite tu u. but, before i klose mi lettur, i want u to exsept mi invitation tu kum and see us at orkners korners. kum enny time, u are always welkum. u will hav no trubbel finding me fur everry budy nose whare rodney gumkirk lives. well i kant think ov enny more tu rite about so all i kan say iz that me and henry and mi dad join in wishen u good luck. so good bi

ures truly
rodney gumkirk

cheef ov the villidge lite and power kumpany.
orkners korners
munroe county
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Compressed Air in Boilers. An Interesting Problem.

EDITOR THE PRACTICAL ENGINEER:

In response to your request for discussion of the "Compressed Air Problem," I will state my views as follows:

It seems to me that it would be very improbable that such a thing could occur for two reasons; first, very few boiler feed pumps would pump air into a boiler under pressure. We all know how difficult it always is to start a boiler feed pump when it once gets filled with air, unless there is some means of relieving the air pressure. The pump will usually just run back and forth without pumping anything.

The second reason is that if the air was pumped into the boiler until air instead of steam escaped at the safety valve, some other means of running the pump than by steam would have to be provided. That is, a pump would not pump more air into a boiler than would be required to run the same pump. If that was possible then the problem of perpetual motion would be solved. Some may say that the air would be expanded by the heat in the furnace, but if there was sufficient fire to do that, there was enough to make steam and the watchman declares there was no steam but air escaping from the safety valve.

Of course, if some of the boilers were cold and the feed pump was run by the steam from some other boiler, it might be possible to pump air into the empty boiler until it escaped from the safety valve; but this was not the case in the circumstances mentioned. If by any means air was compressed or pumped into the boiler, it might not injure it any, yet it is not called good practice, as there is more danger of the com-

pressed air starting leaks when the boiler is cold than there would be by steam at the same pressure.

This problem is a new and interesting one and I expect we shall have some good reading on the subject.

Methuen, Mass. S. J. S.

Compressed Air in Boilers. The Pump will Answer the Question.

EDITOR THE PRACTICAL ENGINEER:

In answer to the question of Elad, of Newtonville, Mass., in the March number of "The Practical Engineer," I would suggest to him that his pump will answer the question. Compare the volumes of both steam and compressed air at the same pressure in the pump and it will be found that the volume of steam will exceed the volume of air.

If the pressure in the boiler did not rise due to the steam generated by the hot walls (assuming the fires to be banked) then the running of the pump as an air compressor would exhaust the boiler down to a balance in the pump cylinder and stop the pump.

It is not an unusual occurrence when shutting down at working pressure for the heat from the walls to run the steam up and popping the safety valve when the margin between the working and the safety valve pressure is set close.

Middletown, Ohio. J. P.

Compressed Air in Boilers. No Harm Would Result.

EDITOR THE PRACTICAL ENGINEER:

In answer to the question: "Will Compressed Air Hurt Steam Boilers?" I don't think that under the circumstances any harm would result. The only harm would be unequal expansion of the boiler due to the air being cooler than the steam, but as the air was forced into the boiler through the regular feed pipe and up through the water and steam in the boiler, it would become heated to very nearly the temperature of the steam and there would therefore be but little difference in the expansion of the boiler.

As for there being no steam in the boiler, I think that there must have been, because if there wasn't, the pump would not have kept running. It would run for a short time on compressed air but would soon exhaust itself as it wouldn't deliver into the boiler as much air as it would draw out. If it did, then you would have perpetual motion.

The blowing of the safety valve was probably due to the compressed air filling the steam space as the steam pressure dropped, and as the pump was pumping air, it raised the pressure to the blowing point.

New Bedford, Mass. F. W. C.

Compressed Air in Boilers. There Would be No Danger.

EDITOR THE PRACTICAL ENGINEER:

The inquiry in the April number of "The Practical Engineer" by "Elad" who wanted to know if compressed air would hurt steam boilers, brings up a question which I suppose many engineers have never thought of.

There could have been no danger from excess pressure if his boiler was piped up in the ordinary way. The safety valve would have carried away all of the air that could be forced through the feed line, no matter how large the pump. The only injury that could result from such a cause would be the cooling of the boiler too quickly and I think this would be impossible with an ordinary size feed pump.

As the specific heat of water is about 4 1-5 times that of air, I cannot see where there is any danger in pumping in air with a feed pump. It is claimed that one pound of coal will heat 1200 cubic feet of free air from 60° to 360° Fahr.; so if there was any fire in the furnace, I do not believe the temperature of the water would be lowered any at all in one hour, which is the time that "Elad" says the pump was running.

While on this subject, I would like to relate an experience I had trying to reheat compressed air. I was employed as hoisting engineer at a mine where the power used to operate the engine and pumps was compressed air. For a short time the power needed was more than the compressor would supply and it was decided to heat the air that was used to run the hoist.

We had a small upright boiler and we moved it as close as possible to the engine and piped the air into it near the bottom and out at the top. The idea was to keep the boiler filled with water and fired so that the temperature would be about 300 degrees. This would be below the boiling point, as the air was compressed to 100 gauge. It worked all right until we tried to hoist a load, when it was found that water would pass over with the air in large quantities. So we considered it a failure.

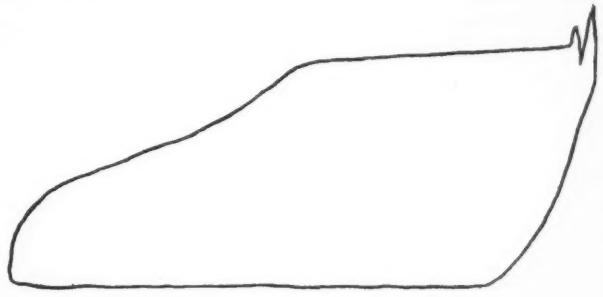
I am of the opinion that if the boilers had been larger or, if there had been more space above the water line, it would have worked all right. I have been told since that the same idea has ben carried out successfully in other places.

Baker City, Ore. N. DECATUR.

What is the Trouble with This Card?

EDITOR THE PRACTICAL ENGINEER:

Herewith please find an indicator card taken from an automatic cut-off engine, 11" x 24", running at 125 revolutions per minute, 80 pounds boiler pressure, 40 pounds indicator spring. What is the cause of the undulations at the start of the steam line? I would like to hear from some of your readers about it.



What is the matter with this card?

I have asked the question of two different authorities and they each gave a different answer. A said that it was caused by momentum, or fling, of the moving parts of the indicator, which shows that the piston was working free and without friction. B said that the piston in the indicator sticks, which causes it.

I rather agree with A but as B is regarded as an expert on indicating, I would like to hear from some brother engineers on this point. If this is caused by a sticky piston, it will be a surprise to me as it works freely and smoothly.

Danbury, Conn. J. M.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

Is Water Pressure more Dangerous than Steam Pressure?

EDITOR THE PRACTICAL ENGINEER:

Is 100 pounds water pressure on a boiler any more severe than 100 pounds steam pressure?

Jackson, Mich. R. B.

One hundred pounds water pressure on a boiler is no more trying than 100 pounds steam pressure. When testing with water pressure, however, care must be taken that the pressure of the water can be controlled, because owing to the fact that water is incompressible, the pressure will often run much above that which is desired. Steam, which is a gas and therefore compressible, can be more easily controlled. For equal pressures the strain on the boiler is the same.—[Ed.]

Lubrication of Condensing Engines. Should Engines be Run Condensing if the Load is Variable?

EDITOR THE PRACTICAL ENGINEER:

Will you kindly answer me the following questions:

(1). How is lubrication effected in the cylinder of an engine, when running condensing, if the condensed exhaust is returned to the boiler?

(2). I have noticed a statement in an engine catalogue that it is not proper to run an engine condensing if the load is variable, as in street railway service. Why not?

Phila., Pa. C. D. H.

(1). Engines running condensing are lubricated in the same manner as non-condensing engines, the oil being removed from the exhaust steam by means of oil separtors or other device before or after condensation of the steam so that no oil is allowed to enter the boiler with the feed water.

(2). Many street railway power plants are run condensing where the cost of the water of condensation is not excessive. If the load on the engine is very variable, at light loads, with an early cut off, the amount of power saved compared with the cost of running the condensing apparatus might not pay. Increased initial condensation in the cylinder due to a high rate of expansion and low terminal temperature may make the difference in the amount of steam used, when the engine is running condensing and non-condensing, a negligible quantity. With large systems this factor of variation may not be so great or it may extend over certain periods of the day when by regulating the number of engines used, they may be all worked to near their maximum capacity and hence always show a gain in economy by running them condensing.—[Ed.]

Boiler Braces.

EDITOR THE PRACTICAL ENGINEER:

Being a subscriber to "The Practical Engineer," I would like to ask a question relating to boiler braces. I have in my possession an engineer's manual which contains a rule for finding the strain on boiler braces, but I do not understand it. I have read a great many books on boilers but have never found one bearing on this question. I am familiar with the strain they are allowed to stand by law, which is 6000 pounds per square inch.

The rule to which I refer is as follows: "Suppose there is a surface exposed to the pressure of 60 pounds per square inch. We must, of course, first find the area of the surface in square inches and multiply it by the steam pressure, which will give the total load. As no more than 6000 pounds per square inch are allowed by law, each 1⅛-inch brace, which has an area of one square inch, will stand 6000 pounds."

Will you kindly explain this further through your valuable paper?

Stillwater, Minn. F. L. K.

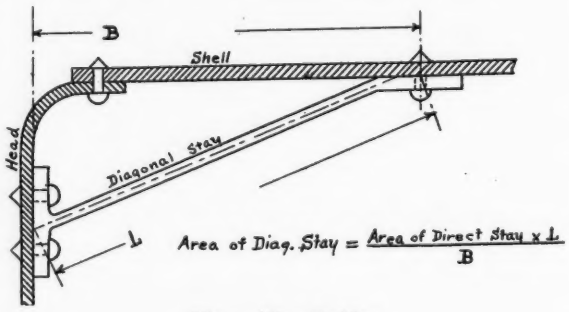
The different rules for finding the strain on each stay, the proper diameter of stays, the proper pitch of stays and area of a diagonal stay are as follows:

To find the strain on each stay, find the area of surface in square inches supported and multiply it by the pressure per square inch carried, and divide it by the number of stays; the quotient will be the strain on each stay.

To find the proper diameter of a stay, divide the strain on one stay by 6000, the quotient by .7854 and extract the square root; the result will give the diameter required.

To find the proper pitch of stays, divide the strain on one stay by the steam pressure and extract the square root; the result will give the proper pitch of the stays.

To find the total area of stays, in square inches necessary, multiply the area of the sheet to be stayed by the pressure to be carried and divide by 6000.



Diagonal Stay Problem

If the pitch of the stays and steam pressure are known, the strain on one stay can be found by squaring the pitch and multiplying by the pressure.

To calculate the area of a diagonal stay, first find the area of a direct stay sufficient to support the surface to be stayed; then the area of the direct stay, multiplied by the ratio of the length of the diagonal stay to horizontal distance from support of stay to area to be stayed, will give the area of the diagonal stay. The accompanying figure will illustrate this latter rule. —[Ed.]

Connecting Rod Boxes.

EDITOR THE PRACTICAL ENGINEER:

I am running a Harris-Corliss cross compound condensing engine and a short time ago the crank pin on the high-pressure side got hot and started the babbitt a little so I would like to take brasses out and see if they are all right. They are adjusted by a wedge and set screws and the connecting rod has solid ends. There is also a dowel pin in the shoulder on the crank pin but I cannot see any on the low-pressure side. You might tell me how to take the brasses off and what the dowel pin in the shoulder is there for.

Fall River, Mass. J. R.

Two types of connecting rods are used in the Harris-Corliss engine, depending upon the size of the cylinder. For all sizes up to 24-inch diameter of cylinder, the solid end rod is used which has the boxes let into a recess cut from the solid end. With this type it is necessary to loosen the boxes by means of the wedges and after taking off the steel plate at the cross head and loosening the bearing, the connecting rod can be lifted from its bearings. The brasses can then be taken out. With the larger size connecting rods, the same arrangement is used on the crank pin end except that a reamed steel bolt is used to retain the boxes in place. The boxes with this type can be removed by taking out the steel bolt which allows a section of the stub end to be removed through which the brasses can be taken apart.

The dowel pin referred to is probably used to prevent the crank pin from turning in the eye of the crank. As usually constructed, the crank pin is forced into the crank and either keyed or dowelled to prevent rotation, the former method being used with a large engine and the latter method for those of smaller size.—[Ed.]

Windings for Motors.

EDITOR THE PRACTICAL ENGINEER:

Will you please give me a rule for finding the right amount of wire to put on the armature of a 110 volt motor? The motor has been wound but has not enough wire on. It runs away and heats up.

Antigo, Wis. C. H. P.

This question cannot be answered without knowing the capacity of the machine, the strength of the field, the number of revolutions and the voltage. It also depends upon the type of winding used and the number of poles.

In general, the number of conductors required on the armature depends upon the strength of the field, the electro-motive force and the speed. The size of the conductors depends upon the amount of current which passes through them. With a given armature more turns could be put on by reducing the size of the wire but trouble would be encountered by overheating. About 600 circular mils cross-section should be allowed per ampere. A mil is the size of the wire in one-thousandths of an inch and a circular mil is the square of the diameter in mils.—[Ed.]

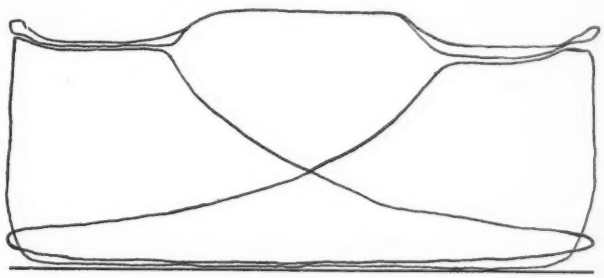
Steam Pipe Diagram.

EDITOR THE PRACTICAL ENGINEER:

Enclosed find an indicator card that has puzzled me for some time. Why does the steam line in the pipe diagram drop down nearly to the admission line of the cylinder diagram when both the steam valves are closed? It seems to me that the line should continue straight to the end of the stroke and then dip during admission, then rise again to boiler pressure and remain there until the end of the stroke is reached. The steam for the pipe diagram was taken just below the throttle valve disc.

Evangeline, La. D. A. G.

It is probable that after cut-off, the pressure in the pipe rises somewhat higher than the boiler pressure, due to the momentum of the column of steam in the pipe and, after it has been brought to rest, the pressure settles down to its normal value. Upon the opening of the valve, the pressure is decreased in the pipe, due to the velocity of steam through the pipe, which, after cut-off, must again be brought to rest and the operation repeated. As the interval of time is very short during one stroke, the column of steam in the steam pipe is constantly surging back and forth, which has the effect of increasing the steam line pressure just the same as it has of decreasing or throttling it. It is only when large pipes or receivers are used that this surging can be made a minimum.—[Ed.]



Indicator Cards and Steam Pipe Diagram

Setting Corliss Engine Valves.

EDITOR THE PRACTICAL ENGINEER:

I am a reader of your valuable paper and have been for some years and I will always stick to it.

I would like you to publish in your next issue, if you please, the correct way to set the valve on a 16″ x 38″ Whithill Corliss engine; that is, explain the amount of lead necessary for the steam valve and also if you would leave the exhaust closed or a little open when the engine is on centre. I have been setting them with 3-32-inch lead on steam valve while I leave the exhaust just 1-64-inch open on the other end, as I think it relieves it of the back pressure. I was told to leave the exhaust closed so as to give the engine a little compression. Kindly explain.

W. Haverstraw, N. Y. D. S.

A method for setting Corliss engine valves was given in the April number. The amount of lead necessary for an engine depends somewhat upon its size. With an engine having a 38-inch stroke, 1-16-inch lead is about the right amount. In reference to the exhaust valves, there is a considerable difference of opinion between engineers as to whether the exhaust valves should be open when the wrist plate is central. Some engineers set them open, some place the edge of the valve and port opening in line, while others set them with a slight lap. The advantage of lapping the exhaust valves is to obtain an earlier closure of the exhaust which gives more compression and at the same time a later release. Different engines require differ-

ent conditions for smooth running and this together with the indicator will decide the best form of card for a given engine. —[Ed.]

Speed of Motors.

EDITOR THE PRACTICAL ENGINEER:

What is the highest possible speed for an electric motor with a direct current of 110 volts? I want to run one at 20,000 or 25,000 revolutions per minute.

Solon, Ohio. F. D.

The limit of speed of an electric motor depends upon its design. The speed is directly proportional to the impressed voltage and inversely proportional to the strength of the field and the number of conductors on the armature. Therefore to get a high speed, it is necessary to have a very weak field and few conductors on the armature.

Aside from the mechanical difficulties which would be encountered when running at the speed mentioned, the difficulties of commutation would not permit of such speed of revolution as 25,000 turns per minute.—[Ed.]

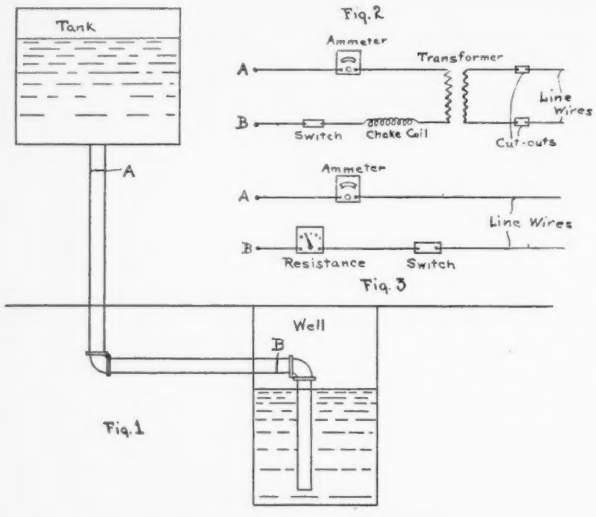
Thawing Frozen Water Pipes.

EDITOR THE PRACTICAL ENGINEER:

Please inform me how by the aid of electricity, frozen water pipes can be thawed out which are laid six feet deep in the ground and are connected from well to tank. Please give diagram as to how to connect wires to pipe and what strength of current is needed.

Stanchfield, Minn. A. T.

When thawing out frozen water pipes it is only necessary to establish a circuit through the pipe so that the heat generated by the current will be sufficient to melt the ice. The



Arrangements for Thawing Water Pipes.

accompanying sketch, Fig. 1, represents a tank and the well from which the water supply is drawn and it is assumed that the pipe is frozen somewhere between A and B, which are two parts of the pipe which are accessible.

The connections are made at A and B, as shown in Figs. 2 and 3, depending on the kind of current used. If alternating current is available, a transformer of suitable capacity is used, the secondary of which is connected to the pipe at A and B through a choke coil, an ammeter and switch. The choke coil is used to regulate the current, the ammeter to give the strength of the current and the switch inserted for the usual reasons. If direct current is used, the line wires can be connected to A and B through a resistance box, ammeter and switch.

The amount of current usually passed through an ordinary frozen pipe is about 200 amperes and the time consumed in thawing out a solidly frozen pipe is about 10 minutes, the time depending upon the strength of current used.—[Ed.]

Answer for J. M., Danbury, Conn.

EDITOR THE PRACTICAL ENGINEER:

In the February issue, J. M., of Danbury, Conn., describes a condition in which his pump will often race and not take the hot water as it should. I would suggest putting a pet cock on the upper water chamber above the upper valves to let out the air.

Seattle, Wash. G. B.

Why Wouldn't the Chimney Draw?

EDITOR THE PRACTICAL ENGINEER:

During the cold weather of last winter, with the thermometer down to 20 degrees below zero, I had some trouble with the draft in the chimney. I have two 80 horse power boilers connected to a brick chimney 75 feet high. The chimney would not draw but the flames would come back out of the fire doors and the only way I could get a draft was to open one of the windows in the boiler room. So long as I had the window open the draft was all right but I had to shut it as one of the sprinkler pipes froze in boiler room and the ¼-inch pipe leading to the steam gauge froze, putting one of the gauges out of business. This happened on two different days but I have never had it happen before or since. I have my ideas as to the cause and remedy for same but would like to hear from some of your readers in regard to it.

Danbury, Ct. J. M.

A Question on Phases.

EDITOR THE PRACTICAL ENGINEER:

In the plant where I work, we have a three-phase generator and I would like to know whether we could put all the load on two phases and none on the other one? One of our engineers says that we can put all the load on one phase and not hurt the machine. Will you kindly answer this?

Chicago, Ill. G. M. McF.

A three-phase generator should have the load equally divided among the three phases. When run on two phases it should not have any more than two-thirds of its rated full load on the machine. The effect of loading all the work on one phase would be to burn out the armature coils in that phase if that work exceeded one-third the capacity of the machine.—[Ed.]

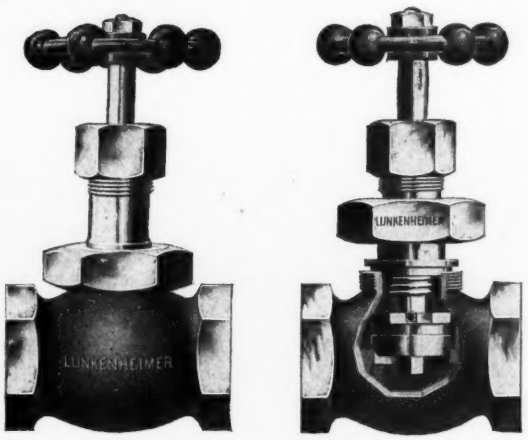
Improved Regrinding Valves.

The Lunkenheimer Co., manufacturers of the well-known high-grade Lunkenheimer Engineering Specialties have made a number of desirable improvements on their regrinding valves. The changes, however, are not radical, as the valve has been in

use for half a century and has proven itself to be of good design. Its manufacturers have, however, increased the weight of the valve, not because the thickness of shell, etc., was too light, but merely as an additional precaution against rough handling while attaching, etc.

The medium pattern valves are guaranteed to stand a working pressure of 200 pounds per square inch and the extra heavy pattern up to 300 pounds per square inch. They have also altered the shape of the valve, which not only makes a more attractive appearance but also increases the area through the valve, the area being more than equal to that of the connecting pipe. To insure a perfect and strong joint between the pipe and valve, the pipe threads have been made considerably longer, thereby overcoming the danger of stripping threads. All sizes of the valves now have lock-nuts on the hand wheels which facilitate the taking apart and assembling of the valve for repairs.

Referring to the sectional illustration, it will be noticed that the hub which carries the operating stem is secured to the body by union connection, which, in turn, screws over the shell of the valve body. By means of this construction it is impossible



Lunkenheimer Regrinding Valves

for the hub and the body to become corroded together, as the thread which holds the union ring to the body is protected at all times from the action of the steam; the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body and tends to make the valve rigid and strong. The disc is held loosely to the stem by means of a lock-nut and therefore will adjust itself on the seat very readily.

The stem is fitted with a strong, deep and long thread and the manufacturers emphatically state that the valve is very easy to operate, and that there is practically no exertion necessary to tightly close even their largest valves. The reason for this is that the hand wheels are so proportioned in respect to the seat opening that no additional leverage need be applied to the hand wheel to facilitate the operation of the valve.

To regrind the valve, the bonnet ring is unscrewed and the trimmings are removed from the body. A wire or nail is placed through the lock-nut and stem, a little powdered sand or glass and soap or oil is placed on the disc and the trimmings are again placed in the valve and reground. The bonnet has a small rim or projection on the bottom thereof which acts as a guide on the inside of the valve neck while regrinding. The seats in the valve-bodies are very narrow when the valves are sent from the factory, which permits of considerable regrinding.

The valve can be packed under pressure when open or closed and to pack while the steam is flowing through the valve, the same is opened as wide as possible when the shoulder at the top of the stem thread forms a seat beneath the stuffing bov.

The material used is of the highest grade of bronze composition and the workmanship is commendable. Before being sent out of the factory, every valve is tested and inspected, the stuffing boxes are packed and they are ready for immediate use.

The Company have, in connection with their plant, a complete physical and chemical laboratory, which enables them to manufacture their products of such composition as is best adapted to withstand the chemical actions, strains, etc., to which the various products are subjected.

Lehigh Council in Mourning.

Lehigh Council, A. O. S. E., of Allentown, Pa., sustained a bereavement during the past month through the death of one of their charter members, Bro. Robert Phifer, who was killed by the bursting of a cylinder head in the wire mill of that city.

At the regular meeting of the Council, held April 5th, the following Preamble and Resolutions were unanimously adopted:

Whereas, It has pleased the Supreme Engineer of the Universe to remove from our midst our late Bro. Robert Phifer; and,

Whereas, The intimate relations held by our deceased Brother since the organization of the Council render it proper that we should place or record our appreciation as an engineer and his merits as a man; therefore be it

Resolved, By Lehigh Council, No. 15, A. O. S. E., that while we bow in humble submission to the will of the Most High, we do not the less mourn for our Brother who has been called from his labor to rest.

Resolved, That in the death of Brother Phifer this Council loses a Brother who was always active and zealous in his duty as an engineer, ever ready to advance the interest of the Council, devoted to its welfare, an honest and upright man, whose virtues endeared him to his Brethren in the Order.

Resolved, That this Council tender its heartfelt sympathy to the family and relatives of our deceased Brother in this, their sad affliction.

Resolved, That a copy of the resolutions be entered upon the minutes of our Council and a copy sent to the family of our deceased Brother, also a copy to "The Practical Engineer" and each of the city papers for publication, and that our charter be draped in mourning for a period of thirty days.

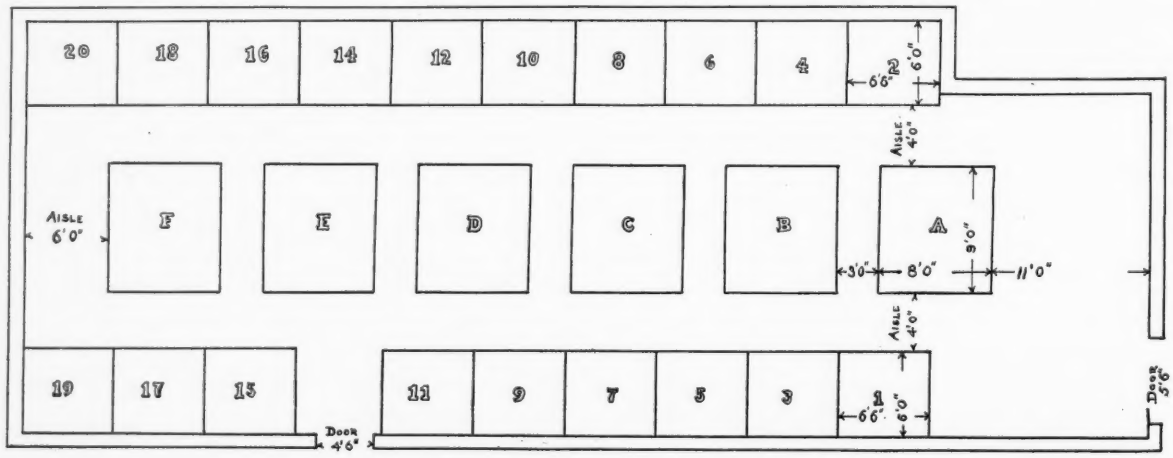
WM. STAHLER, Chief Engineer.
A. J. STRAUSS, Financial Engineer.
A. P. DREISBACH, Recording Engineer.

Steam Turbine Lectures.

Kensington Council, No. 3, A. O. S. E., and Northeast Association, No. 20, N. A. S. A., both located in the northeastern part of Philadelphia, were each recently entertained by an illustrated lecture on "The Steam Turbine." Both of these meetings were crowded, which shows the interest taken in this subject. The lectures were given by Mr. Harry Y. Haden, who entertained the Northeast Association, at Kern's Hall, on April 5th, and Kensington Council, at A. P. A. Hall, on April 6th. The members of the last-named Council had a scrap with the janitor of the building about using all the chairs in the other rooms, illustrating the interest taken in their course of instructive lectures.

The Coming A. O. S. E. Convention.

The Nineteenth Annual Convention of the American Order of Steam Engineers which is to be held in Philadelphia, June 12th to 15th, promises to be an event of more than ordinary interest. The local committee, who have charge of the arrangements, have been working energetically for several weeks and already have the preparations well in hand. The convention will be held in Harmonie Hall, at 525-535 North Eleventh Street, which is an admirable location and within a few minutes walk from the centre of the city. An attractive and interesting feature will be an elaborate exhibition of machinery, steam specialties and engineers' supplies, which will be held on the first floor of the same building. This floor has been apportioned off in sections, as shown in the diagram reproduced herewith, and will be rented to those wishing to exhibit their products, thus offering an excellent opportunity for demonstrating the special features of each article to a large number of prospective consumers. Any one wishing to take advantage of this opportunity must hurry up, for most of the spaces are already taken and the few remaining ones will doubtless be gone long before the Convention meets.



Plan of Exhibit Room for the Coming A. O. S. E. Convention

Ample provision will be made for the accommodation of manufacturers of engineering appliances and their representatives; committees will be on hand to meet and entertain the delegates and visiting members of the Order, and all together, it gives promise of being a joyful occasion for all. Any one desiring further, or more specific information, with regard to exhibition space or other details, should address the Secretary of the Committee of Arrangements, Mr. Harry R. Myers, 2023 North Second Street, Philadelphia.

Pennsylvania Gets an Engineers' License Law for Second and Third Class Cities.

April 5, 1905, will mark an epoch in the affairs of the engineers of Pennsylvania, as on that day Governor Pennypacker approved and signed an Act of the Legislature, giving to cities of the second and third class an Engineers' License Law. This good work was accomplished by the earnest and conscientious efforts of the State License Law Committee, which had been appointed by the President of the Pennsylvania State Association, of the N. A. S. E., C. W. Snyder, of Philadelphia, and consisted of Mr. John C. Wollin as Chairman, Vice-President of Pennsylvania State Association, and a member of Williamsport Association, No. 8; Mr. John Buggy, of Chester Association, No. 2; and Mr. W. Blevens, of Keystone Association, No. 25, of Pittsburg. The Act as passed and approved is the same substantially as is now in successful operation in the City of Philadelphia, and was originally, on February 23d, introduced by Representative Schad, from Pittsburg, at the request of the United Committee from Pittsburg, but covered only cities of the second class, not knowing at that time that this law was presented, Representative H. Troxel, from Williamsport, through the instrumentality of Mr. Wollin, Chairman of the State License Law Committee, introduced an Amendment to the law for first class cities in order to make it applicable to cities of the second and third class, this was simply attached to the Act then before the House, and passed, after being referred to the Senate it encountered some objection from certain members. Mr. Wollin at once sent word of the state of affairs to President Snyder, who called on the Deputy-President, Mr. R. Pape, and they together paid a hasty visit to Harrisburg, where they met Mr. Wollin and appeared before the Senators successfully arguing the different objectionable points, so that it passed second reading that night, and final reading in the Senate, March 21st, and was approved and signed by the Governor, on April 5th, as stated above.

Too much praise cannot be given to the State License Law Committee, Chairman Wollin and the other members of the Committee who went ahead like "veterans" and when it was necessary to go to the Capitol at Harrisburg, they went with a will, and an unselfishness which is highly commendable, and will undoubtedly bring its reward when it becomes generally known that it was due to their earnest labors that the engineers throughout the State owe their thanks for the present License Law.

The successful passage of this law should be an incentive for the engineers of other States to take early and aggressive action looking to the eventual accomplishment of similar results, and the best way to begin is to form strong State organizations and give them unanimous and unselfish support.

It is now up to the engineers of every third class city in Pennsylvania to see to it that their respective cities make immediate provision for the creation of the office of boiler inspector. And do you know how to do this? Why, hustle for

it; call a meeting at once of all the engineers in your city; don't wait for some other fellow to do it; talk the matter over and formulate a plan of action. Then act, persistently, everlastingly, and don't let up until you get it; otherwise many third class cities will have a long wait for this law to become effective. In every third class city there are good engineers who are competent to act as boiler inspectors. Not all third class cities can afford to pay fancy salaries sufficient to compensate their inspector for his full time, but in such cases the duties would be correspondingly light and the fees of the office should be ample to compensate the incumbent for the time and labor devoted to the work.

Following is the text of the law in full:

AN ACT.

To provide for the better protection of life and property by the examination and licensing of engineers having charge of steam boilers, steam engines and appliances connected therewith in cities of the second and third class of this Commonwealth and providing penalties for violation.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met and it is hereby enacted by the authority of the same, That it shall be unlawful for any person or persons to have charge of or to operate a steam boiler or steam engine over ten horse power in cities of the second and third class of this Commonwealth except locomotive boilers used in transportation and steam engines and steam boilers carrying less than fifteen pounds pressure per square inch unless said person or persons are upwards of twenty-one years of age and holds a license as hereinafter provided for, and it shall be unlawful for any owner or owners user or users of any steam boiler or steam engine over ten horse power other than those excepted above to operate or cause to be operated a steam boiler or steam engine without a duly licensed engineer.

Section 2. All persons desiring authority to perform the duties of an engineer shall apply to the boiler inspector of such cities who shall examine the applicant as to his knowledge of steam machinery and his experience in operating the same, also the proofs he produces in support of his claim and if upon full consideration the inspector is satisfied that the applicant's character, habits of life, knowledge and experience in the duties of an engineer are all such as to authorize the belief that he is a suitable and safe person to be entrusted with the powers and duties of such a station he shall grant him a license upon the payment of three (3) dollars authorizing him to be employed in such duties for the term of one year, and such license shall be annually renewed without examination upon the payment of one (1) dollar, provided it is presented for renewal within ten days after its expiration. Licenses so granted shall be graded into two classes. One of which shall entitle the licensee to have charge of or to operate stationary steam boilers and steam engines only, the other of which shall entitle the licensee to have charge of or to operate portable steam boilers and steam engines only, such licenses shall not be transferred from one grade to the other without a re-examination, said re-examination to be conducted without cost to the licensee.

No person shall be eligible to examination for a license unless he furnishes proof that he has been employed about a steam boiler or steam engine for a period of not less than two years prior to the date of application, which must be certified to by at least one employer and two licensed engineers.

Section 3. The inspector shall investigate all acts of incompetency or misconduct committed by any licensed engineer while acting under the authority of his license and shall have power to summon before him any witnesses within his respective city and compel their attendance by a similar process as used in the State courts to compel the attendance of witnesses, and he may administer all necessary oaths to any witnesses thus summoned before him, and after reasonable notice in writing given to the alleged delinquent of the time and place of such investigation such witnesses shall be examined under oath touching the performance of his duties by any such licensed engineer, and if the inspector shall be satisfied that such licensed engineer is incompetent or has been guilty of misdemeanor, negligence, unskilfulness or has endangered life or wilfully violated any provision of this law he shall immediately suspend or revoke his license as the facts of the case may require.

Section 4. Every engineer who receives a license shall before entering upon his duties make oath before the inspector to be recorded with the application that he will faithfully and honestly, according to his best skill and judgment, without concealment or reservation, perform all the duties required of him by law.

Section 5. Every engineer who shall receive a license shall, when employed about any steam plant, place his certificate of license, which shall be framed under glass, in some conspicuous place about the engine or boiler where it can be seen at all times, and any neglect to comply with this provision by any engineer shall be deemed a misdemeanor, and upon conviction thereof, he shall be subject to a fine of not exceeding one hundred dollars or the revocation of his license or both, in the discretion of the court.

Section 6. All engineers licensed under the provisions of this law shall assist the inspector in his examination of any boiler under his charge and shall point out all defects and imperfections known to them in the boilers or machinery, and in default thereof the license of any such engineer or engineers so neglecting or refraining shall be revoked by the inspector.

Section 7. Every person who has been employed as a steam engineer in the city in which he applies for a license for a period of four years next prior to the passage of this act, and who files with his application a certificate of said fact under oath accompanied by a statement from his employer or employers verifying the same, shall be entitled to a license without further examination.

Section 8. It shall be the duty of an engineer when he assumes charge of boilers and machinery, to forthwith thoroughly examine the same, and if he finds any part thereof in bad condition caused by neglect or inattention on the part of his predecessor, he shall immediately report the facts to the inspector who shall thereupon investigate the matter, and if the former engineer has been culpably derelict of duty he shall suspend or revoke his license.

Section 9. It shall be the duty of every licensed engineer when he vacates a position as engineer to notify the boiler inspector of such fact and any failure to comply with this provision shall be punishable by a suspension of the license for such period or periods as the boiler inspector may determine.

Section 10. Every owner or lessee or agent of the owner or lessee of any steam boiler or steam engine over ten horse power embraced within the provisions of this act or any appliances connected therewith, and every person acting for such owner, lessee or agent is hereby forbidden to delegate or transfer in any manner whatever the responsibility or liability for the management or operation or the maintenance in good condition and repair of any such steam boiler or steam engine or appliances connected therewith to any person or persons other than a licensed engineer in charge thereof as shown by compliance with section two of this act, and any violation of the provisions of this section shall be deemed to be a misdemeanor to be punished by a fine not exceeding five hundred dollars ($500) or by imprisonment not exceeding three months or both at the discretion of the court; provided, however, That on the purchase or agreement to purchase a new steam boiler or steam engine over ten horse power or appliances connected therewith the builder or builders thereof may contract or agree with the purchaser or purchasers to accept said responsibility for a period not to exceed sixty days, provided that there is to be a licensed engineer in attendance thereon.

Section 11. All fees received under this act shall be paid into the treasury of the city wherein the license is granted.

Section 12. Any violation of the provisions of section one of this act shall be deemed a misdemeanor to be punished by a fine not exceeding five hundred dollars or by imprisonment not exceeding three months or both at the discretion of the court.

Section 13. Any officer charged with a duty under the provisions of this act who shall fail to discharge the same or comply with the requirements thereof, shall upon conviction, be punishable by a fine not exceeding five hundred dollars or by imprisonment not exceeding three months or both at the discretion of the court.

Section 14. This act shall not affect any third class city until the councils of said city shall by ordinance provide for the creation of the office of boiler inspector therein.

Section 15. All acts or parts of acts inconsistent with this act are hereby repealed.

TRADE NOTES

EDITED BY THE ADVERTISING MANAGER

The advertising representatives of a large number of concerns engaged in the manufacture of machinery and allied industries have formed an organization to be known as the Technical Publicity Association. The first Annual Meeting, Dinner, and Election of officers will be held in the rooms of the Hardware Club, in the Postal Telegraph Building, New York City, on the evening of April 27th, when an address will be delivered by Mr. E. P. Harris, well known as a broker of trade and technical journals.

Crane Co. have just issued their advance circular describing Crane Steam and Oil Separators, for the separation of water from live steam, and the elimination of oil from exhaust steam; made in sizes from 1 to 30 inches, in the following types: horizontal, vertical, angle, and distributing. This circular contains 26 10½ x 13½ sheets, printed on white enameled paper, and handsomely illustrated from halftone engravings. It will be sent upon request. Ask for "Advance Circular No. 01."

We are advised by Mr. A. C. Lippincott, General Manager of the Lippincott Steam Specialty and Supply Co., and the Indicator Instruction Co., that the business of these two Companies has been increasing far beyond his original expectations. Several months ago he started with a lot of indicators, reducing wheels and planimeters, which seemed to be large enough to provide for all reasonable requirements, but before completion, orders were on file for all of them and about 150 more. He states that he is now making 1750 instruments, and hopes that with this start there will be no cause for complaint among his customers and among the students of the Indicator Instruction Company, who, by the way, get an indicator free with each scholarship for practice, and when all payments are completed, this indicator becomes their property. Further particulars of his work may be had by addressing him at 95 Green Street, Newark, N. J.

The Sterling Exhaust Head is sent on trial, freight prepaid, and the interesting part of it is that it not only takes the oil and condensation out of the exhaust steam, but it does it without causing any back pressure. Any steam plant owner or engineer who is troubled with exhaust pipe showers of water and oil should write for further particulars to the Sterling Pipe and Blower Manufacturing Co., Hartford, Conn.

Enough Palmetto Twist Packing for trial will be sent free to any engineer upon request. This may seem like an unusual offer but the manufacturers of this packing are making it because they are confident that after trying it you will want to use it regularly. When any concern offers a free trial of their products, they usually have confidence in its merits and that's a good sign. If any of our readers want to test the merits of "Palmetto," they should write to Green, Tweed & Co., 17 Murray Street, New York City.

If you have any gauge cock troubles it will pay you to write for a circular describing Cadman's Ball Valve Gauge Cock with positive outside shut-off. The valve is reversible and it's easy to repair. Address A. W. Cadman Manufacturing Co., Pittsburg, Pa.

Dodge & Day, Engineers, Philadelphia, Pa., who were commissioned some time since by the Lehigh Coal and Navigation Co. to take charge of their extensive improvements at Lansford, Pa., including new building, machine tools and electrical equipment—in fact, all details in connection with such a layout—have been further commissioned to take charge of the erection of a new centrally-located power plant. This plant will provide current for the shops, Tamaqua and Lansford Street Railway, and electrical equipment which will be installed in the mines for pumping and transportation purposes. Dodge & Day are now investigating the latter subject and specifications will shortly be sent out by them. Mr. Herbert Clarke, Engineer of the Tamaqua and Lansford Street Railway, will co-operate with them.

The many friends of Mr. W. C. Johnston, so well known to the machinery trade, will be pleased to hear of his connection with the Diamond Drill and Machine Co., of Birdsboro, since the severance of his connection with Alexander Foster, of New York. Mr. Johnston will be a machinery salesman for the Diamond Drill and Machine Co., representing their Wagner Cold Saw, Jackson Belt Lacing Machines, Punches, Shears, Rolling Mill Machinery, Open Hearth Steel Castings, Air Furnace and Cupola Castings, etc.

A new circular has just been issued describing Tulley's Handbook on Engineering, a copy of which will be mailed to any one interested. Address Henry C. Tulley, Wainwright Building, St. Louis, Mo.

Richards-Corliss Steam Engines are interestingly described and handsomely illustrated in a new and very pretty catalogue, just out. Any one interested in Corliss engines should know the Richards-Corliss, for its reputation among those who have used it is unequalled. If you are interested send for the catalogue.

Shallow's Automatic Water Gauge is a simple device which automatically and instantly shuts off the entrance to the glass water gauge when the glass breaks, thus preventing the escape of steam or hot water. This is something that will be appreciated by engineers who have been the victims of bad burns from this cause or who at some former time have had their boiler room flooded. The Shallow gauge is handsomely finished and a decided ornament, as well as a useful article. It is fully described in an illustrated circular which will be sent free to any engineer by Wm. S. Haines Co., 136 South Fourth Street, Philadelphia.

The Sterling Lubricator Co., of Rochester, N. Y., have just equipped the New York Stock Exchange plant with thirty of their Sterling force feed lubricators. This power plant cost over a million dollars. It is four stories below the street and is probably visited by more sightseers than any other steam plant in the world.

V. D. Anderson & Co., Cleveland, Ohio, manufacturers of the Anderson Trap, are doubling the capacity of their plant by the erection of a large addition to their present buildings.

Any one who is interested in the problem of economical combustion by modern methods should write to the Wilkinson Manufacturing Co., Bridgeport, Pa., for a copy of their stoker catalogue.

The Canton Steam Pump Co., Canton, Ohio, are building a large addition to their plant.

A Metallic Packing for gas engines is the latest product of the factories of the France Packing Co., 6514 State Road, Tacony. For a long time this house has been experimenting, with more or less success, but have finally been rewarded by attaining what is claimed by users to be the best packing for this class of work ever invented. The makers are naturally reticent about its make and composition, but will gladly furnish particulars to any one interested.

This Gas Engine Packing is to be sold under the same conditions as govern the other outputs of this plant—*i. e.*, the coupon system by which any engineer, master mechanic, or superintendent can equip his entire plant with all necessary tools, free of charge. Send for particulars to above address.

The H. A. Rogers Co., 19 John Street, New York, desire to announce that they have made permanent arrangements with Mr. E. W. Saunders to devote special attention to the machine tool department, which has always been an important adjunct to their line. Mr. Saunders has for many years been identified with the machine tool trade in New York and being well versed in machine tools and their uses, his views will benefit purchasers, especially those seeking outside aid in selecting plants for manufacturing machinery on the interchangeable plan with greatest economy. The H. A. Rogers Co. represent the well-known firm of Bentel & Margedant, Hamilton, Ohio, manufacturers of high-grade wood-working machinery.

Principals not represented in New York territory can secure active co-operation in the sale of their product for equipment of mills, mining property, factories and machine shops.

The Buckeye Boiler Skimmer Co., of Toledo, Ohio, have just installed Buckeye Skimmers on the six large return tubular boilers of the Pope Motor Car Co., of Toledo. They have also equipped all the boilers at the refinery of the Paragon Refining Co., including six fire tube, one water tube and one internally fired boiler. No similar device has ever had such a large

sale as the Buckeye Skimmer and the fact that many of the largest concerns are now equipping their entire boiler plants with them is the best evidence of their value for removing dirt and scale-forming material from steam boilers. A handsome catalogue issued by the Company illustrates the method of applying the skimmer to different types of boilers. A copy of this catalogue will be mailed to any one interested.

The Chicago office of the Crandall Packing Co., of Palmyra, N. Y., has been removed from 30 and 36 La Salle Street to 52 West Washington Street, where it occupies a store on the ground floor.

The Cherry Chemical Co., manufacturers of the Red Seal Boiler Compound, No. 10 North Nineteenth Street, Philadelphia, Pa., desire to thank their many friends and customers for their kind expression and well-wishes for their success in the new quarters.

The Company has been better able to ship Compound with more promtpness than heretofore on account of the offices and mill being located under one roof. They tell us that they think their quarters are too small for the increase of their business. However, they will be compelled to put up with it and probably their next move will be to a building owned by themselves.

Any information that the trade desires in regard to Red Seal Boiler Compounl can be had by addressing the Company.

Mr. Oliver Braden, the genial manager for the past twelve years, is still continued at the head of the Company.

"Well I'll be—turned!" said the Pulley, when the Belt Man took a stick of Stephenson Bar Belt Dressing out of his tool box.

The Crandall Packing Co., of Palmyra, N. Y., with stores at 136 Liberty Street, New York, and 52 West Washington Street, Chicago, are offering to engineers, as an inducement to use one of the best packings, a unique clock for the engine room. This Company manufactures High-Pressure Ring and Coil Packing, Expansion Steam Packing, Gum Core, Diagonal and Water-proof Hydraulic and various packings, Valves, Sheet Rubber and a general line for all classes of plants. They will send you a clock upon receipt of coupon with your name and address when ordering twenty-five pounds of their packing, either direct or through a jobber. The more packing, the more clocks. Do you want one?

The April calendar of the Kutztown Foundry and Machine Co., 116 North Broad Street, Philadelphia, is interesting as usual and a decided novelty. Any of our engineer readers who are interested in boiler castings, grate bars, etc., should write to this enterprising concern and get their names on the list for their monthly calendar.

Engineers or others who are interested in traction engines, for any kind of service, portable engines for saw mills, threshing grain, etc., should write to Frick Co., Waynesboro, Franklin Co., Pa., and get one of their illustrated circulars showing illustrations of the various types of their Eclipse engines and boilers.

The American Water Softener Co., of Philadelphia, Pa., and Columbus, Ohio, reports that installations of the Brunn-Lowener Water Softener have been made in the United States, England, Germany, Russia, Spain, Denmark, Sweden, Austria, Japan, South Africa, Argentine Republic, South America and Chile.

A valve for controlling the feed pump that will automatically maintain a water pressure always in excess of the steam pressure is described in a circular which will be sent to any of our readers, upon request, by The Federal Valve Co., 2534 Western Ave., Seattle, Wash.

The new 1905 catalogue of the Chicago Injector Co., of Wadsworth, Ohio, is now out and ready for distribution. A copy will be mailed to any reader of "The Practical Engineer" upon request. Address Chicago Injector Co., Wadsworth, Ohio.

The City of Philadelphia recently made a ten hours' test of a single valve Watertown engine. The results of said test are given in detail in a large circular just issued by the Watertown Engine Co., Watertown, N. Y. A copy of this test sheet, together with a half-tone picture of the engine, will be mailed to any of our readers.

A DELIGHTFUL AFFAIR.

Only a few years ago the Norristown Covering Co., of Norristown, Pa., was one of the smallest concerns in its line; now it is one of the largest and is still growing with marked rapidity. One of the reasons for this marvelous growth was beautifully illustrated on Tuesday evening, April 18th, at the Company's third annual banquet, given in honor of its employees. The object of this banquet, like those that have preceded it, was to more firmly establish the bond of fellowship between the Company and the men and in this, as in all other respects, it was a complete success. Every member of the Company was present, including its president, Dr. Weaver, and every employee from "Chimmie," the office boy, to the manager's private secretary, Miss Wilkinson, who, by the way, judging from the reception accorded her, is the idol of the entire force. Several of the branch office managers were present, including those of New York, Boston, Philadelphia, and several others. All of these gentlemen vied with each other in bestowing praise upon the employees of the factories for the all-around excellence of the coverings which they are producing, each claiming that the goods, and not the salesmen, have been the real cause of the immense demand for them.

Mr. Chas. S. Platt, the general manager for the Company, made an efficient and jovial toastmaster, keeping everybody always in a high state of good humor, and in return Mr. Platt was praised and complimented from all sides. Indeed, any man who by his force of character and kindly personality can hold the united esteem and genuine affection of such a large body of employees and business associates may well be envied.

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